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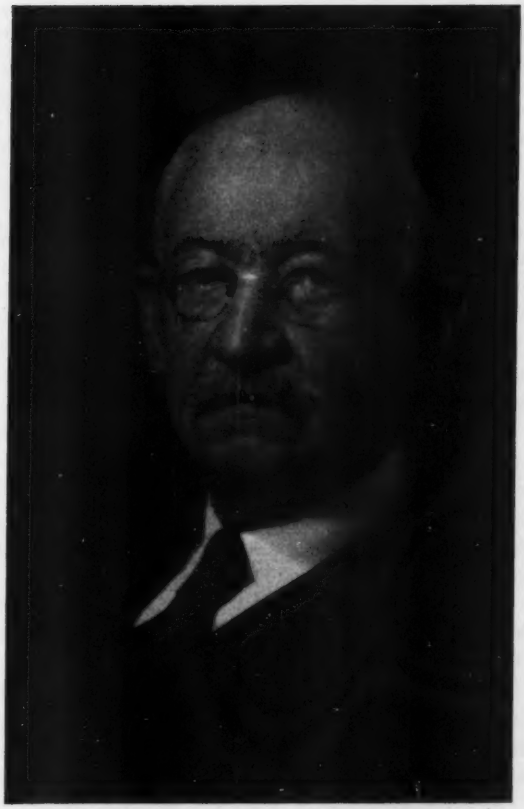


FREDERICK EUGENE TURNEAURE

Dean, University of Wisconsin, awarded the tenth Lamme medal by the Society for the Promotion of Engineering Education at its forty-fifth annual meeting at Massachusetts Institute of Technology and Harvard University, June 28–July 2, 1937

Frederick Eugene Turneaure

FREDERICK EUGENE TURNEAURE was born on a farm near Freeport, Illinois, on July 30, 1866. He was graduated in civil engineering at Cornell in 1889 and immediately engaged in railway engineering work.

In 1890 he became an instructor in civil engineering at Washington University in St. Louis, and in 1892 he was appointed Professor of Bridge and Hydraulic Engineering at the University of Wisconsin, the title becoming Professor of Bridge and Sanitary Engineering in 1898. In 1902 he was appointed Acting Dean, and in 1904, Dean of the College of Mechanics and Engineering of the University of Wisconsin. The latter position he has held continuously since his appointment.

In addition to his teaching and his administrative activities as Dean of the College of Engineering and Director of the Engineering Experiment Station of the College, Dean Turneaure, through his technical papers and texts, has made distinguished contributions to engineering science and practice. He has been responsive to civic and professional obligations, and in a number of important appointments has well served his community, his commonwealth, and the engineering and teaching professions.

Dean Turneaure served as city engineer for Madison, Wisconsin, for 1900–02. He was an ex-officio member of the Wisconsin Highway Commission during the important period of highway building from 1911 to 1929. He is chairman of the Wisconsin Registration Board of Architects and Professional Engineers 1932–. He served as President of the Society for the Promotion of Engineering Education in 1908–09 and was a member of the Board of Investigation and Coordination which directed the comprehensive study of engineering education carried out by the S. P. E. E. over the period 1923–1929.

Dean Turneaure conducted pioneer experimental and analytical investigations on impact and secondary stresses in bridges under moving train loads, and also on the strength of steel columns. His papers dealing with these studies appeared in the Transactions of the Am. Soc. of Civil Engineers beginning in 1899 and in the bulletins of the Am. Ry. Engr. Assoc. By virtue of this work and of his treatment of the principles of reinforced concrete design, Dean Turneaure has served as an active contributing member of the following professional committees:

"Committee of the Am. Engr. Railway Association Devoted to Iron and Steel Structures."

Chairman, 1924–33, of the "Special Committee on Steel Column Research" of the A. S. C. E.

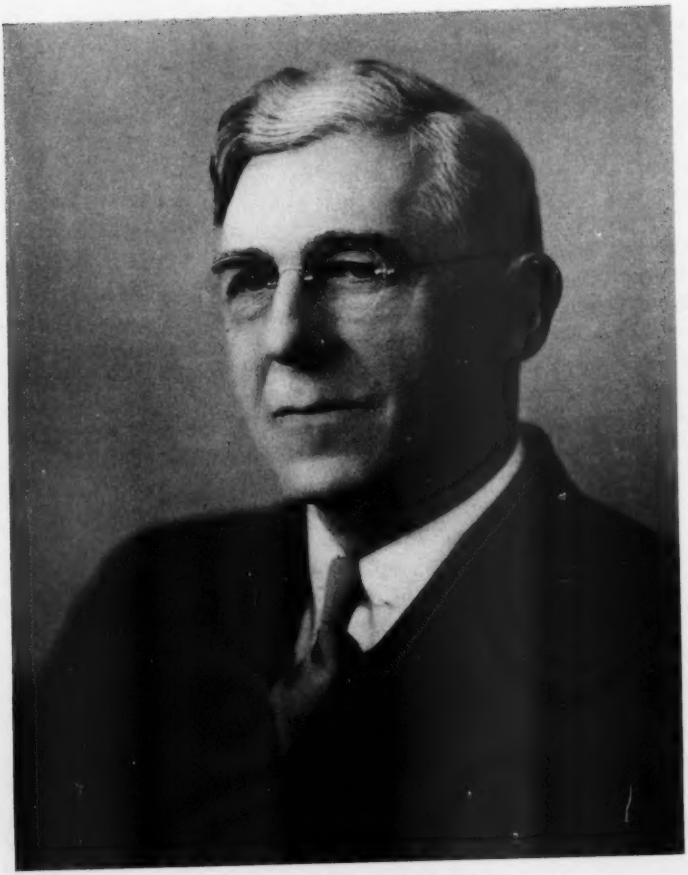
First "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" (1903–1916).

Dean Turneaure's pioneering studies resulted in the writing of early texts which have been revised as the engineering arts have advanced and are in use to-day. The first of these is the well known three volume work " Theory and Practice of Modern Framed Structures " written in 1893 in collaboration with Johnson and Bryan. This was followed by " Public Water Supplies " written with H. L. Russell in 1900. " Principles of Reinforced Concrete Construction " written with E. R. Maurer appeared in 1907.

Special recognition of the soundness and significance of Dean Turneaure's professional contributions has been accorded by the awards and honorary memberships that have come to him:

Doctor of Engineering, University of Illinois, 1905; " Octave Chanute Medal " by Western Society of Engineers, 1907; " Turner Medal," American Concrete Institute, 1930; Honorary Member, American Society of Civil Engineers, 1934; Fellow, American Association for the Advancement of Science; Member, American Railway Engineering Association, American Society for Testing Materials, Society for the Promotion of Engineering Education (Pres. 1908–09), Western Society of Engineers, Engineering Society of Wisconsin (Pres. 1909–10), Milwaukee Society of Engineers, Tau Beta Pi, Phi Kappa Phi, Sigma Xi, Chi Epsilon.

" In my thirty-five years with the Westinghouse Company, my greatest pleasure has been to see many young men grow from pupils to assistants and associates. I have aimed to instill in them fundamental ideas of engineering honesty and honor, square dealing and fair fighting—that there should be pride in accomplishments because true engineering means much more than merely making a living—it means advancement of the art for the benefit of mankind."—*Benjamin Garver Lamme.*



SAMUEL BROADUS EARLE

SAMUEL B. EARLE

President, S. P. E. E., 1937–38

Samuel Broadus Earle is dean of the School of Engineering, professor of mechanical engineering, and director of the engineering experiment station, Clemson Agricultural and Mechanical College, Clemson College, S. C. He was born at Gowensville, S. C., in 1878, and was educated at Furman and Cornell Universities.

Professor Earle has been connected with Clemson College ever since he was graduated from Cornell in 1902. He was assistant professor of mechanical engineering for one year, associate professor from 1903 to 1910, director of the engineering department and professor of mechanical engineering from 1910 to date, and also director of the engineering experiment station since 1924. The college has its own light and power plant, two pumping stations, and independent sewage system, all of which come under Professor Earle's supervision. He designed and installed the ice and refrigerating plant, designed a central-heating plant for several college buildings and a large church in connection with the college, and had charge of the wiring and plumbing of all residences on the campus.

Professor Earle was acting president in 1919 and again filled that office from the death of Dr. Riggs in January, 1924, until July, 1925. From 1918 to 1920, he was a member of the Public Service Commission of South Carolina and also was consulting engineer for the Apple Valley Orchard and Nursery Company.

Professor Earle served on the council from 1927 to 1930; has been nominated for the office of Manager, American Society of Mechanical Engineers; is a member of the South Carolina Society of Engineers, serving as a director in 1929 and 1930 and as president in 1933; and a member of the National Engineering Council Committe on Unemployment; from 1932 to 1935, he was chairman of the engineering section of the Association of Land Grant Colleges and Universities. He is a Fellow of the American Association for the Advancement of Science and the South Carolina Academy of Science and a member of Tau Beta Pi, the national scholastic honorary engineering fraternity. Furman University conferred the degrees of A.B., A.M., and LL.D. in 1898, 1899, and 1932, respectively, and Professor Earle received an M.E. from Cornell University in 1902.

EDITORIAL

By S. B. EARLE, President of the Society

Since most of the membership of the Society for the Promotion of Engineering Education consists of men and women from all parts of North America it is natural that the meetings should be held in various parts of the country from year to year.

The last meeting was held at the Massachusetts Institute of Technology, noted for its undergraduate work, graduate work embracing all the fields of engineering, and for the wonderful research along so many lines of engineering, physics, chemistry and many others, and at Harvard, that oldest of our institutions, that has had such a remarkable career and has influenced to so great a degree higher education in this country. Because of the meeting place with such a background, in the heart of so much of historic interest, and because of the program, it is no wonder the attendance of 1586 was the largest in the history of the Society. There was so much of interest to see and so much in the program one wanted to hear it was difficult to decide what to attend. The conferences were well attended and much interest was shown in the discussions.

The meeting next June will go to the great State of Texas, where, because of its vastness, distance means so little. The meetings will be held at the A. & M. College of Texas at College Station but it is hoped that visits can be made to the University at Austin, Rice Institute at Houston, and other places of interest. Both the University and the A. & M., because of their wealth in land and in oil wells, have shown a marked growth in their physical plant in recent years. They have also grown in number of students and in faculty. The type of work done there is also well recognized, not only in Texas but throughout the country. While the meeting place is quite a distance for some of the members of the Society I am sure that all who attend will find it worthwhile. It will also give an opportunity for many to attend who normally can not get to a national meeting. The Texans are proud of their state and of their colleges and I am sure will be fine hosts. Everyone may expect a fine welcome and the best of attention.

Besides these institutions there is the modern and growing city of Houston, the old city of Galveston, the beautiful and historic city of San Antonio, and many others.

Those driving cars may be interested in visiting the West Coast

or a trip over the beautiful new highway to Mexico City, or in going East to the old historic city of New Orleans.

Regardless of the place of meeting the Society has always shown great interest in all phases of engineering education. In the early days of engineering the training of the engineer was almost wholly by the apprentice method but as advance was made it became necessary to develop special educational training. Since the organization of the S. P. E. E. it has had a great influence on the advance and stabilization of this training.

Because of invention and application the field of engineering has become so broad that there has been a tendency to crowd too much in the regular four-year undergraduate courses.

Probably one reason engineering education has been as successful as it has is because the curricula have not stressed factual information but rather the study of the fundamental laws and the application of these along with logical and straight thinking to the correct solution of problems.

The application of science to agriculture, the research work of the agricultural experiment stations and the development of agricultural machinery by the engineer have made it possible to increase production to such an extent that fewer and fewer people are required to feed the increasing population of the world.

Through the efforts of the engineer machines and manufacturing methods have made it possible to produce the ever increasing necessities and luxuries with fewer working hours per day.

This increased leisure of the masses has come about so rapidly that a new social order has come upon us which will require time for readjustment. The engineer has had a lot to do with causing this condition and has a responsibility in bringing about a solution to this as well as some of our economic problems. The effect of this has been reflected to some extent in our curricula in the past few years.

While recognizing the responsibility of the engineer, I feel that too much time cannot be given to these studies in our undergraduate courses. Elementary courses may be offered and problems should be forcibly brought to the attention of the students along with the teaching of other engineering subjects and by the engineer who can best interest the students in such problems. Special training along these lines as well as any other lines should be left for graduate work, to be pursued by those specially interested in and specially qualified for such studies. The training for the design engineer or the research man should naturally be more advanced and more specialized than that of the ordinary practicing engineer.

It is hoped that the interest of the S. P. E. E. will continue along all phases of engineering training and that the stress in our undergraduate work may be placed on a *thorough grounding* in the laws basic to engineering, with time in which to teach the student to *think* and *think straight*, leaving much of the specialization study to graduate work.

The E. C. P. D. can do much in bringing to the colleges better engineering material, in improving the quality of the training of that material in college, and particularly in continuing that training after graduation and in helping the graduate to make readjustment necessary for college life to the life in the world for which he has been preparing.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

Selected Bibliography of Engineering Subjects

The Committee on Professional Training of the Engineers' Council for Professional Development has just published five pamphlets which, taken together, should prove helpful to those in search of competent guidance in engineering literature. Primarily intended to aid the beginning engineer in choosing his reading, the lists should also be of service to librarians as guides in book purchasing.

The bibliography appears in five sections: (1) Mathematics, Mechanics and Physics; (2) Aeronautical and Civil Engineering; (3) Chemical and Industrial Engineering; (4) Electrical and Mechanical Engineering; (5) Metallurgical and Mining Engineering. The choice of works has been confined to current American publications and, in general, to those of college grade. Annotations are provided.

These lists represent the considered opinion of a large number of teachers and professional engineers, which gives them an authority above any others known to the present writer. The separate pamphlets can be had for ten cents each, or for five cents in lots of fifty, assorted if desired.

Harrison W. Craver

THE ENGINEERING TEACHER *

By H. P. HAMMOND

President, Society for the Promotion of Engineering Education; Professor of Civil Engineering, Polytechnic Institute of Brooklyn

It is the principal purpose of this convention to consider the engineering teacher—his work and the conditions under which he does it, his preparation for teaching, and the social significance of the service he renders. I conceive it to be my function to deliver this address as a general foreword to the several parts of the program that are to follow.

In doing so I would direct attention first to certain features of the general system of higher education which influence the work of the engineering teacher to an important degree.

Never before has there been such universal faith in what education can do to promote social progress as exists in this country to-day. If by education we mean the whole process by which men learn, both in and out of school, this faith is well founded, and it is well that it exists. But whether schooling alone can accomplish all that seems to be expected or believed of it is another matter. It is not in the least necessary to deprecate academic education to attempt to appraise some of the limitations and imperfections of our system of schools and colleges. To consider but one of these: Higher education in this country is unique in that we have placed so many eggs in a single basket. Taken as a whole, and not forgetting certain exceptions, we have virtually but one pattern of higher education: the American collegiate system. With the endorsement and support of a large part of the population this system is growing with astonishing rapidity and now comprises more than 1,000 colleges and universities, about 450 junior colleges (omitting certain types), about 1,250,000 students, and over 100,000 teachers. To an important extent it is the result of the well-nigh universal feeling of our people that it is the degree or nothing in higher education. This belief is understandable among a people holding to the democratic ideal of an open path leading clear to the top for every young man and woman, but it creates a vast confusion of aims and purposes in the educational process. There is more than a little truth in the saying attributed to Barrett Wendell that if the

* Presidential Address delivered at the 45th annual meeting, S. P. E. E., Cambridge, Mass., June 28–July 2, 1937.

bachelor's degree could be conferred on every child in the United States at birth the interests of education would be greatly advanced.

The engineering teacher feels the effect not only of this widespread belief but also of another factor that has suddenly become important: the enactment of engineering registration laws, which in turn have been the direct cause of the accrediting of engineering schools. I shall not add to the current discussion of this movement except to say that while it can be, and has already been, of considerable benefit to engineering colleges, it has its dangers, for which we must be continually on guard. It also has inherent faults, not the least of which is the tendency still further to cause the engineering college to become almost the sole agency of preparation for a tremendous diversity of industrial pursuits. In the one institution the attempt is made to prepare young men of widely varying abilities for such a great variety of services, both as to types of work and levels of responsibility, that the process inevitably becomes one of compromise. I am measuring my words when I say that I believe this compromise goes so far as seriously to handicap our institutions in the purposes they aim to serve and their teachers in what they attempt to accomplish. For the benefit of both it seems clear that greater diversification of types of institutions and of educational programs is required if the needs of industry and students are to be served effectively.

The Junior College

There is nothing new in these statements; they have been made in this Society before. Justification for their repetition rests in what consideration may now be given to means through which diversification may be sought. There seems to be in sight but one promising means of any considerable magnitude: the publicly supported junior college. If this new institution can become a means of aiding in the selective admission of students to the later years of engineering study; if it can provide terminal programs suitable for those who cannot or should not proceed further and thus aid in the preparation for a great variety of pursuits to which the customary type of professional engineering program is not well suited, the general interests of engineering education will be materially promoted. If, on the other hand, the junior college is to become chiefly a competitor for students; if it is to be ambitious to become a senior college; and if it is to send increasing numbers of students to the advanced years of engineering study with inadequate preparation, our general situation will but become more difficult and confused.

Whatever the trend of developments may be it is clear that the

junior college is a force to be reckoned with, and that this Society must participate in the reckoning. We have two committees at work in this field, and are to hear the report of one of them later this week. Such work should be continued and extended; junior colleges offering engineering should find a suitable place for participation in our activities; our policy should be one of coöperation with these new institutions, not of complaint about them.

Engineering Teaching as a Vocation

The foregoing is a statement concerning a general condition that limits the effectiveness of the work of the engineering teacher. In contrast there are many attributes of our vocation for which we may have a sense of gratification and pride: security, in comparison with most other pursuits; freedom, in the main, to teach in accord with our individual ideas and temperaments; a degree of liberty possessed by almost no other group to hold and to express our personal views on almost anything; modest dignity of position; decency of life and environment; the pleasure of dealing with young people at the best period of their lives and the gratification of serving them usefully; the satisfication of dealing with things objectively, of teaching with a discernible end in view and of being able to measure results (most gratifying attributes of engineering as contrasted with many other fields of teaching); and, of greatest importance of all, a sense of the well-nigh indispensable value of our services to society. These concomitants of our work, which we perhaps remember too infrequently, are such as to make the vocation of engineering teaching one to which almost anyone in the profession at large might well aspire.

This is the brighter side of the picture. Of course it has its darker side. Not to dwell at length or unprofitably on its less favorable aspects I would mention but one: the general level of meagerness at which the work of so many engineering teachers is done. I refer particularly to insufficiency of facilities and to lack of time for other than routine work. The currently heavy load of scheduled teaching and accompanying duties that prevails in a great many engineering colleges in this country is such as seriously to limit the participation of their teachers in constructive scholarly work. It is not that too much is expected in the aggregate, but the fact that the load is so badly balanced. No good teacher begrudges any of the time he devotes to teaching. But he wants also, or should want, to have enough time free from routine duties to keep alive his interest in investigation, or professional practice, or writing; he wants to have an opportunity to keep exercising his creative faculties that he may continue to grow in mental stature. The

condition of meagerness to which I refer is due chiefly to the expansion of higher education beyond the limits of adequate support, as well as to the general prevailing economic situation. We can but hope that this may change, and that present conditions of stress may be relieved.

Selection and Development of Teachers

I turn next to the selection and development of teachers, topics that are to be dealt with later during this convention.

As to the selection of teachers my thesis is this: If as much care were devoted to the choice of a beginning instructor as to the search for a head of a department many of the problems of the teaching staff would be greatly simplified and some of them would disappear. How many times within the experience of most of us has the appointment of an instructor been dictated by immediate expediency, and how often have problems thus been created that it has been difficult or impossible to solve satisfactorily or with fairness. A great deal is to be said for the policy followed in some institutions of appointing beginning instructors for a limited probationary period with the definite understanding that reappointment is not implied.

It would be difficult to overestimate the importance of systematic efforts to develop younger staff members. How effective such efforts may be is indicated very clearly by the examples of those institutions to which we look year after year when we seek a teacher of framed structures, or of chemical or electrical engineering, or of mechanics. Some mature teachers possess the ability and the urge to aid in the development of their younger colleagues. Not all institutions can be fortunate enough to possess such men, but it is not beyond reason to hope that aiding in the development of its younger teachers might be the practice as well as the policy of every institution.

One other point in relation to the development of the teacher: We have heard from time to time of the plan of exchange of teachers among engineering schools for periods of a year or two. A great deal may be said in favor of this plan; as has been remarked, the human plant is likely to benefit by an occasional repotting. The details of administration through which exchanges may be effected have been thoroughly worked out, yet few institutions have given the plan a trial. Since the difficulties may be easily solved under the circumstances that prevail in a good many institutions it might be hoped that the policy of exchange of teachers might be extended considerably.

Induction into Teaching

How is the beginning teacher inducted into his job? Bliss Perry, speaking of his own experience at Williams, might be describing that of a good many beginning teachers of engineering when he says—"I became the pioneer of a long line of young fellows who had to learn their job by doing it. Perhaps it is not the worst way to learn, though one's pupils may suffer in the process." The practice of leaving the young teacher—sometimes under watchful supervision, but usually without any planned guidance—to work out his own destiny is a severe and a searching discipline. How different it is to go as a student to class to recite on a given chapter and to go for the first time to meet a class as a teacher of that chapter! I may be pardoned, perhaps, in citing my own experience when I was serving as a "section hand" at Pennsylvania. I remember vividly that in my first two years after graduation I taught—or perhaps in some instances it would be more accurate to say "heard recitations in"—engineering drawing, descriptive geometry, materials testing, hydraulics—with laboratory, sanitary engineering, surveying, and mechanics of materials, with scarcely a word of guidance or criticism and with but one visit by an older teacher to my classroom, for which he apologized by saying that it was required by the Board of Visitors. This may be a somewhat extreme example, but except as to quantity it is probably not unlike the experience of many other young men starting in our profession by the sink or swim method.

Of late a new factor has entered the preparation of engineering teachers: the requirement that candidates for appointment must hold advanced degrees. Though this practice is a recent one, it has spread so rapidly that its effects are already evidenced by the admirably equipped group of younger teachers that is growing up around us. But it would be well in thinking of the undoubted benefits of advanced academic work to keep in mind that engineering deals with actualities and that no preparation for teaching it is adequate that does not include first-hand experience with those actualities. It is equally clear that the conditions of an engineering teacher's work should be such that, in one way or another, he can maintain contact with professional practice sufficiently to keep alive his sense of its realities. A paper by Hardy Cross, entitled "The Elusive Sense of Reality," which appeared in the publication of the Civil Engineering Division of this Society brings out vividly the need for the teacher constantly to keep in touch with the ends his teaching is intended to serve. As a warning of what may occur otherwise I repeat Professor Cross's quotation from the writings of A. N. Whitehead: "The child has to be taught the words that

correspond to the things; the senior at college has lost the things that correspond to the words."

Learning to Teach

What has just been said leads naturally to consideration of another aspect of the development of the teacher: how he learns to teach. I think it may be said that many of us had about as much control over this as we had over the choice of our grandfathers, for we learned to teach chiefly by copying the methods of those who, by chance, taught us. Of course we modify these methods as we go along, but I suspect that most of us can still detect, as I certainly can, the influence of some of the teachers under whom we studied. If the development of teaching procedures were traced back to their origins, it is probable that in many instances methods in widespread use to-day would be found to have originated in a single institution or to have been developed by a single man. This is strikingly true of Pickering in the laboratory sciences, and may also be said of Church in mechanics, Carpenter in engineering laboratory work, and probably others.

But the chief effect that individual teachers have exerted on engineering education has been on content and arrangement of subject matter—and thus indirectly on methods of instruction—through their writings. One of the most potent factors affecting engineering instruction in this country is the textbook. It would be difficult to overstate the influence that has thus been exerted through the books of a few influential writers, such, for example, as Mansfield Merriman. An interesting chapter in the history of engineering education might be written around the influence of the textbook. It should deal, among other things, with what is sometimes spoken of as "teaching the textbook instead of the subject."

Qualities of the Teacher

I come now to the most difficult part of this subject—discussion of the qualities, professional and personal, that the teacher should possess. It is not difficult to prepare a catalogue of such attributes: integrity; tolerance; leadership; a sense of humor; that liking for young people which is the basis for all successful work with them; breadth of knowledge and of understanding coupled with mastery of subject and zeal for its presentation; ability to see things in their elemental form; the knack of inducing the student's self-development as contrasted with ability to cram him—all of these and more could be listed as those we should like to feel characterize the great body of engineering teachers; and perhaps they do. But even if it could be certified that any one of us, or all of

us, possessed all of such a catalogue of virtues, something would be left out that distinguishes every great teacher. When we begin to deal with personalities—with men's souls—we encounter something akin to a fourth dimension that eludes classification and defies measurement by any means at our command. We are dealing no longer with things at which we can look from a superior viewpoint and analyze and classify. If one would have a sense of this let him take the blue volume of *Proceedings* of this Society for 1898, the year in which the first Boston meeting was held, and read through the list of members of that year. There are only 226 names, so it will not take long. Not a member of the Society here present will fail to recognize several of those names or to know enough about the men to sense what it is of which I am speaking. I read a brief sampling from that list, from which I omit all present members of the Society: William H. Burr, Rolla C. Carpenter, A. Jay Du Bois, Robert Fletcher, Estevan A. Fuertes, John Galbraith, W. F. M. Goss, Ira N. Hollis, John B. Johnson, Gaetano Lanza, Edgar Marburg, T. C. Mendenhall, Mansfield Merriman, Michael I. Pupin, William G. Raymond, Palmer C. Ricketts, W. T. Sedgwick, Henry W. Spangler, George F. Swain, Robert H. Thurston, C. M. Woodward. Even if these of the great men of our profession had each possessed all the virtues that I have enumerated—which is by no means true—there would not have been included some fundamental element upon which their standing is based. I shall not attempt to name this element, for I cannot; because each teacher, great or otherwise, is an individual and not a type.

What is important, however, is to know how such men as these may be identified and selected when they are young and how, once they are chosen, they may be provided with the conditions under which they may develop their abilities and work effectively. How are the fine teachers of the future to be recognized? The process is often as elusive as the qualities themselves. For most of us the safest course is to secure all the information we can concerning the candidate, make our guess, and then carefully but unobtrusively watch the young man through a probationary period. To some, however, it seems to be given to possess this ability to choose (and later to develop) young men, as is shown by some of the faculties—not necessarily the large ones—that have been gathered together. "Also he knew men at once," it was said of Cosimo de' Medici, "when he looked into their eyes." But this is an ability that but few of us possess.

Our Social Era

Up to this point I have been concerned with a number of specific aspects of teachers and teaching. What follows deals with the

general nature of the social era in which the engineering teacher functions and the place he occupies in it.

It has become a commonplace to say that we are living in an age of science and technology. Like all such sweeping generalizations concerning anything so complex as a civilization this statement is incomplete and to that extent inaccurate. Other fundamental factors should be named in attempting to characterize it, including at the very least economics and education.

Whatever words may be used to designate the nature of our present era—by which I mean that which began about 150 years ago when scientific discoveries, and especially the development of mechanical power, began to be applied widely to the common pursuits of life—it is clear that it is the first of its sort in the history of the race. Previous civilizations have been based upon agriculture, upon religion, upon militiary domination, but never before has one been based upon industrialism. Because our age is different we may be inclined to assume that it is superior to previous ones. Whether, fundamentally, it is or is not the future will have to determine; it is yet to be proved, certainly, that it has within it those elements making for stability that are necessary to insure reasonable permanence.

What is it, fundamentally, that differentiates this age from those that have preceded it? Certainly it is not alone the new things with which we have surrounded ourselves and on which our mode of life is so largely based. It is not wholly the processes by which these things are made, though such a large proportion of the population is engaged in these proceses and is profoundly affected by them. Nor is it even the fact that we now understand and control the natural laws upon which those processes depend. It is in part a combination of all these elements, but more fundamentally it is the method that has been evolved by which the laws themselves are discovered and by which they are applied. It is the procedure that we call the "Scientific Method"—the sequence of systematic observation, analysis, generalization, and application, coupled at times with the exercise of a sort of intuitive scientific perception, together with the concentration of that method upon problems of our physical environment that distinguishes our time from previous times. It is the very widespread understanding of this method that no longer limits to the great geniuses—the Galileos, the Newtons, the Faradays, the Carnots—the ability to contribute to the advancement of science, but that makes it possible for those of more modest abilities, such as you and me and our students, to participate in it according to our capacities. It is that method which has created the necessity for the whole scope of our professional activities, and that brings us here together.

The development of the method through which physical laws are discovered and applied is one of the really great achievements of the race during its long history, to be classed in importance with such fundamentals as the creation of language and the development of moral philosophy. For it is by means of that process that command has been achieved over the resources of materials and energy in nature so that they may be applied to the use and convenience of man and thus make possible a so much richer and better world in which to live.

It would be rash indeed, however, to say that the great ability so created is being used as effectively as it might be to create the sort of world it ought to make possible. It has become a commonplace, also, to say that achievements in science and engineering have far outstripped developments in economics and politics and sociology. And the evidence about us shows all too plainly that this is indeed the case. What is so often called for is the development of a method that would serve those fields as well as the scientific method has served ours. It may be a mistake, however, to assume that the same, or perhaps even the same sort of, process would be applicable; for in the physical and biological sciences we deal with inanimate matter or with insensate forces, or at most with organisms simpler than our own, and even in medical science we deal with the body essentially as a mechanism. Whereas in the other fields I have mentioned events or circumstances cannot be separated from the human factor—from our intellect—which we cannot regard from a superior viewpoint and which we cannot, therefore, so readily comprehend and deal with systematically. Indeed, the difficulty of working out a basic method of solving economic and social problems lies in considerable measure in the fact that we are ourselves a part of the problem, influenced by our own emotions and self-interests. It is again the element of the "fourth dimension" of human nature for which we have as yet evolved no systematic units of expression or method of measurement. And yet not to believe, or at least to hope, that we have within ourselves the ability eventually to devise means of dealing more satisfactorily than at present with problems of life other than those that are essentially physical would be to adopt a philosophy of incapability or even of despair. The best grounds for hope that this is not beyond the realm of possibility is perhaps the fact that we seem in the immediate past to have come to a more widespread awareness of these problems than has existed before. If our misfortunes of the past twenty-five years may thus aid in the eventual working out of a "scientific method" of the social sciences they will have been worth all they have cost. It is our clear duty as teachers not only not to ignore education in this aspect of the

modern world, but rather, without neglecting the accepted purposes of our educational programs, to lead our students rationally and sensibly to consider these aspects of their environment and their lives. We have these young men under our direction for four of the most valuable and formative years of their lives. During that time we hold the chief responsibility, among those from whom they learn, not only of guiding their thinking and developing their abilities in science and engineering, but also of molding their attitude toward a great many other things that will effect their future. It is a responsibility that we cannot escape.

To summarize, the statement so often heard of late may be repeated, that it is the scientist and the engineer who occupy the key positions in modern society. And I believe proof of the validity of this statement may be adduced. If this be so, it follows of course that the engineering teacher should occupy a place of great and basic importance in the world to-day. We may ask ourselves whether he does in reality occupy such a position. The foregoing parts of this address discuss some of the factors which must be considered in arriving at an answer to this question: his selection, training, development and personal characteristics; the conditions under which he does his work; and the nature of the educational system and the social era in which he functions. These topics and others are to be dealt with more completely in the course of the program to which this foreword is intended to serve as an introduction. Let us hope that when the convention ends it may have contributed to a broader knowledge and a clearer understanding of the engineering teacher and his work to the end that our Society may contribute still further to the promotion of his personal and professional development.

WELCOME

By VANNEVAR BUSH, Massachusetts Institute of Technology

Members of the Society for the Promotion of Engineering Education and Guests: It is my privilege to welcome you to New England and in particular to the city of Cambridge, after a lapse of twenty-five years, for the purpose of holding a convention in our midst. I assure you that the welcome is none the less sincere because you have already been here several days. I feared somewhat that you who have been about here to various meetings and have not been welcomed, might feel that the general committee which I represent was a little lukewarm because we have let such a long time elapse before we greeted you officially. I assure you, however, that that is not the case. We are delighted to have you here and the welcome has been delayed merely that it might be expressed to a larger group.

I know of no convention to-day which has as much goodfellowship and which is as enjoyable as the conventions of the Society for the Promotion of Engineering Education. There are a great many groups meeting in this land here and there about this time. Some of them have before them the question of how to pry out of their neighbors an unearned increment; others have before them the problem of estopping others in their natural occupations. Here is a group, gathered together for the very simple purpose of studying how a good job which is being done for the benefit of the entire people can perhaps be done better. It is a pleasure, amid the turmoil that there is in the country to-day, to join with a group that has this very simple but nevertheless very important affair before it.

We are anxious that you should have a good time in order that you may come back again, after a lapse of less than twenty-five years, to enjoy our hospitality and to gladden our hearts by being a short time in our midst.

By H. M. WESTERGAARD, Harvard University

The spirit of inquiry has been nourished by the soil of Cambridge for three centuries. This spirit prevails to-day. It is in harmony with it that Harvard University through its Faculty of Engineering salutes you. For you are here to inquire into some-

thing that matters: the preparation of men for the profession controlling the forces of nature in the service of mankind. Harvard University has ties of active and living friendship with Massachusetts Institute of Technology and happily joins M. I. T. in greeting you who have come from other institutions. At this meeting all are united in a purpose of collaboration. We welcome the members, the ladies and the guests. We hope you will find the surroundings pleasant, profit by the companionship, and derive benefit from the meeting. Harvard University welcomes you.

By CARL S. ELL, New England Section

It is a distinct pleasure for me to extend to you a welcome from the New England Section. As you know, the Section naturally includes the six New England states. In that area, there are fourteen engineering colleges and 299 members of the Society. It is these 299 for whom I speak. For those of you who are academically inclined, there are in this New England area, over one hundred colleges and universities with their doors open to you. There are art museums and libraries full of treasures such as the Boston Public Library with its murals by Sargent. There are the homes and by-ways once inhabited by America's famous authors such as Longfellow, Lowell, Whittier, and Holmes; and other alluring points of interest.

For those of you who enjoy history as Americans made it, we have old North Church where the lantern was hung for Paul Revere; Lexington with its village green where Americans first dared to call their souls their own; Concord and its bridge where the shot was fired that is still being heard around the world; Bunker Hill and Faneuil Hall; the spot of the Boston Massacre; and the only space on earth where tea was made from salt water.

We have Salem, where fear ran riot in the days of witchcraft; Plymouth, with its rock where the Pilgrims are supposed to have landed. For those of you who, after this convention is ended, are looking for a vacation land, we invite you to follow the Indian trails through the Green Mountains of Vermont or the White Mountains of New Hampshipe or the Berkshire Hills of Western Massachusetts and Connecticut, or follow the paths of Roger Williams through Rhode Island or travel through the virgin forests of Maine.

We invite you to sail our fresh water lakes or the deep salt sea or fish in New England waters. We invite you to travel over our miles of perfect highways, through green hills and valleys and quaint New England villages, with their tall, white, eloquent church spires. We invite you to help yourself to our endless miles

of shore line with its white sand beaches, invigorating sea breezes, and warm sunshine. As Dean Bush has already said, the sun usually does shine in New England and the temperature usually at this time of the year is a little above what it is to-day.

We urge you to stay long enough after this meeting is over to become acquainted with New England. I am talking, of course, to the people from outside of New England. Perhaps you will meet some of our characters, such as the religious fanatic who was traveling the countryside and came by a farmer plowing in the field, and since he was a religious crank he said to the farmer, "Have you made your peace with God?" When the farmer heard a voice he shifted his cud of tobacco over to the other side of his mouth and spat some brown juice on a place where grass will never grow again and said, "What did you say?" The fanatic said, "Have you made your peace with God?" The farmer thought a moment and then said, "Well, I wouldn't go so far as to say that but so far there hain't been no open break."

RESPONSE TO ADDRESSES OF WELCOME

By PRESIDENT HAMMOND

There have been as you know, three previous meetings of the Society held here in the Boston district, two regular meetings and one special meeting. The first regular meeting was held in 1898. At that time, there were 226 members of the Society and there were 69 persons in attendance at the meeting. The next meeting was held in 1912, the one to which Dean Bush referred as having been held twenty-five years ago. Then the attendance reached 215.

This year, the new members admitted to the Society were 265, more than either the total attendance in 1912 or the total membership in 1898. Our attendance at these meetings has gone this way: In 1898, 69. In 1912, 215. This year, until six o'clock last evening, 1,520. 60 per cent of our entire membership is represented on the enrollment lists thus far.

I think that is the best response that we could give to your words of welcome. If 1,586 of our group come here, what further need I say concerning the appeal of Harvard and the Massachusetts Institute of Technology and New England?

I express to you, I am sure, the wish of our Society that you should feel that we are thoroughly enjoying ourselves, that these great institutions have inspired us to come here and that we shall leave here the better for our visit.

MINUTES OF COUNCIL MEETINGS

June 28–July 2, 1937

Present: H. P. Hammond, I. C. Crawford, S. A. Harbarger, W. O. Wiley, F. L. Bishop, C. E. Davies, F. L. Plummer, C. F. Allen, G. P. Boomsliter, G. W. Case, P. T. Norton, J. W. Barker, M. M. Boring, L. E. Grinter, T. H. Morgan, S. W. Dudley, O. W. Eshbach, H. J. Gilkey, E. A. Holbrook, F. W. Marquis, R. W. Morton, R. L. Sweigert, D. C. Jackson, F. E. Turneaure, A. N. Talbot, C. F. Scott, A. A. Potter, O. M. Leland, R. L. Sackett, R. A. Seaton, W. E. Wickenden, C. C. Williams, D. S. Anderson. (33)

The reports of the treasurer, W. O. Wiley, and of the secretary, F. L. Bishop, were received and ordered printed.

The secretary was instructed to convey to Mr. Wiley Council's very great appreciation of his thirty years' service as Treasurer of the Society and his part in the success of the Society.

C. C. Williams, Chairman of the Committee on Relations with other Engineering Societies, presented the recommendation of that Committee, which Council adopted, that the 1939 meeting be held at The Pennsylvania State College. (The 1938 meeting is to be held June 27–30 at the A. & M. College of Texas, College Station.)

In view of exceptional circumstances, Council authorized the Executive Committee, at its discretion, to arrange a special meeting on the West Coast in 1939 in the San Francisco Bay district. (In a letter dated July 1, 1937, Stanford University and the University of California "would rather relinquish the 1939 meeting than insist on a division, if the 1940 meeting could be held there.)

Council approved the formation of the University of Arizona Branch and the Mineral Technology Division. The petition for a division on tests, examinations and guidance was laid on the table.

The Executive Committee is to study and report next year on

1. Policy of the Society with regard to publications issued by divisions and other branches of the Society.

2. Formulation of policy for committees and divisions of the Society.

3. At its discretion, the Executive Committee may arrange a special meeting on the West Coast in 1939. (See quotation from letter from Stanford and University of California.)

Council adopted the following resolution:

"To the Carnegie Foundation for the Advancement of Teaching the Council of the Society for the Promotion of Engineering

Education wishes to express its appreciation for a grant of $2,500 which has made it possible for the Society to undertake a comprehensive study of instruction in English in engineering colleges. It is the hope of the Council that this generous gift may result in the improvement and development of this important phase of the education of engineers."

Any division or group desiring to hold a summer session or conference at any time other than at the annual meeting and using the name of the Society must secure authorization of Council or Executive Committee before doing so.

Chairman G. W. Case reported that the parent society does not give as much attention as it should to sections and branches. He recommended that officers of the Society and Council members attend meetings where possible. He also recommended that $500 be appropriated for travel of these members and for the subsidization of sections. This recommendation lost.

Council suggested that sections invite new members of the Society to these meetings and that some recognition be given them at that time.

The Editor of the JOURNAL OF ENGINEERING EDUCATION is not expected to abstract papers for publication but is authorized to request authors to reduce manuscripts to a minimum.

All publications, other than the JOURNAL OF ENGINEERING EDUCATION, bearing name of the Society shall be approved by the Publication Committee of the Society before issuance.

Engineers' Council for Professional Development.

Accrediting of Engineering Colleges. H. P. Hammond reported that all schools making application for accrediting would be visited before fall and that a report would be made of such schools about October first.

Professional Recognition. J. W. Barker reported for this Committee and was instructed by Council to prepare a report covering all phases of the report and send it to the secretary who would send it to Council for study. Council is to act on this report at the 1938 meeting.

Student Selection and Guidance. R. L. Sackett reported for this Committee and will prepare a brief summary for the Journal.

Professional Training. O. W. Eshbach reported for this Committee and referred to the activities of junior engineers at Providence, R. I. He asked for suggestions regarding this work to be sent to him at 195 Broadway, New York City. It was suggested that Council and boards of direction of other engineering societies assume leadership in this work.

Appointments: W. O. Wiley was appointed a committee of one to prepare a resolution felicitating the University of Pittsburgh

on its 150th anniversary and to thank the Chancellor and the Board of Trustees for their courtesies to the Society in the twenty-three years the Office of the Secretary has been located there.

R. E. Doherty was appointed a representative on the Engineers' Council for Professional Development.

F. L. Bishop was appointed a representative on the American Council on Education.

Committees on technical institutes, methods of instruction, and terminal program were authorized.

Changes in the Constitution and the By-Laws of the Society and Rules Governing the Council, as submitted by the Committee on Institutional Membership.

Council approved and recommended for adoption by the Society three new sections to the By-Laws to be numbered ninth, tenth and eleventh, respectively. These new sections are:

Ninth. Any educational institution which has one or more of its curriculums accredited by the Engineers' Council for Professional Development shall be considered as "recognized" within the meaning of the constitutional requirement for active institutional membership, and no other educational institution within the United States or its territorial possessions shall be so considered.

Tenth. Any engineering degree-granting educational institution in continental North America, outside of the United States, shall be considered as "recognized":

(*a*) If one or more of its engineering curriculums have been accredited by an agency whose standards are adjudged by the Council of the Society to be not lower than those of the Engineers' Council for Professional Development, or

(*b*) If no suitable accrediting agency is available to appraise its engineering curriculums, but one or more of these curriculums are adjudged by the Council of the Society, upon satisfactory evidence, to meet standards not lower than those of the Engineers' Council for Professional Development.

Eleventh. Any Junior College or other educational institution giving instruction which is adjudged by the Council of the Society, upon satisfactory evidence, to be substantially equivalent to the first two years of one or more curriculums accredited by the Engineers' Council for Professional Development shall be considered as among those institutions "giving instruction in engineering" within the meaning of the constitutional requirement for associate institutional members.

(Present "ninth" section to be renumbered "twelfth." Additions or amendments may be made to these By-Laws at any regular meeting of the Society by a two-thirds affirmative vote of the membership present at the business session, provided that the additions or amendments shall have been approved by a two-thirds affirmative vote of the Council membership in attendance at the meeting, and shall have been recommended by that body for adoption.)

The above sections were unanimously approved by the Society at a regular business session.

Council voted, if and when the Society adopted the proposed new tenth section of the By-Laws, that we should add to the list of active institutional members the Canadian institutions which are listed as institutional members in the year book.

Council approved and recommended for adoption by the Society an amendment to the Constitution to make the first two sentences of the second paragraph of Article II read as follows. (New material in italics.)

"Membership in the Society shall be of two general classes, Institutional and Individual.

"Institutional members shall be of two classes, active and associate. The active institutional members shall be recognized institutions giving baccalaureate or equivalent degrees for curriculums in engineering, *and distinguished national professional engineering societies.* Associate members shall be other educational institutions giving instruction in engineering. Institutional members shall be entitled to representation at all meetings of the Society or its divisions by regularly appointed delegates, one for each institutional member concerned."

The members of the Society are hereby notified of the proposed amendment to the Constitution. Final action will be taken at the next regular meeting of the Society in College Station, Texas, June 27–30, 1938.

The following recommendations of the Committee on Institutional Membership were also adopted by Council:

That the list of present institutional members be classified by the Council as active institutional members and associate institutional members, and that the classification be published in the next issue of the Year Book; those institutions whose curriculums are still under consideration by E. C. P. D., or whose classifications have not been determined by the Council at the time the next issue goes to press, being so designated in the published list.

That pending action by the Society upon the proposed amendment to the Constitution, The Engineering Institute of Canada be included in the list of active institutional members of the Society.

That the classification of institutional members be revised annually by the Council to conform to changes in the E. C. P. D. list of accredited curriculums; those active institutional members whose curriculums have all been removed from the accredited list being transferred to the associate membership list, and those associate institutional members one or more of whose curriculums have been accredited being transferred to the active membership list.

That a committee on institutional membership, of five members including the president and secretary of the Society ex officio, be appointed annually by the president of the Society. It shall be the duty of this

committee to assemble data and information relating to institutions which have made application for membership, and to make recommendations to the Council in respect to approval of such applications, necessary changes of classification, and other matters pertaining to institutional membership in the Society.

Council thanked the Committee—R. A. Seaton, Chairman, D. C. Jackson and R. L. Sackett—and recommended that they be reappointed for 1937–38.

The following new members were elected:

Adams, Charles J., Professor of English, Worcester Polytechnic Institute.
Anthony, Richard L., Professor of Mechanical Engineering, Bucknell Univ.
Atkinson, Margaret B., Instructor of Drawing, Texas Tech College.
Bailey, Wayland S., Assistant Professor of Mechanical Engineering, Univ. of Maryland.
Banks, Charles W., Head, Dept. Applied Science, Wentworth Inst.
Bartlam, Edward R., Principal, Ceylon Tech College, Colombo.
Bennett, Ralph D., Professor of Electrical Measurements, Mass. Inst. Tech.
Brown, Francis W., Instructor in Chemistry, Drexel Inst.
Burdell, Edwin S., Dean of Humanities, Professor of Sociology, Mass. Inst. Tech.
Clark, Roy E., Assistant Professor of Heat Power Engineering, Cornell Univ.
Cope, William J., Associate Professor of Mechanical Engineering, Univ. Utah.
Davis, Stuart B., President, American Soc. Heating & Ventilating Engineers.
Everett, Albert E., Assistant Professor of Coordination, Northeastern Univ.
Fair, Fred C., Instructor in Chemical Engineering, New York Univ.
Fountain, Alvin M., Associate Professor of English, No. Car. State College.
Glendinning, William, Instructor, Education Bureau, Cons. Edison Co. of N. Y.
Guthrie, Albert N., Associate Professor of Physics, R. I. State College.
Hargis, Andrew B., Dean, School of Engineering, Univ. of Miss.
Hoones, John A., Instructor in Mechanical Engineering, Mass. Inst. Tech.
Hughes, C. A., Associate Professor of Structural Engineering, Univ. Minn.
Jacklin, H. M., Professor of Automotive Engineering, Purdue (reinstatement.
King, Robert M., Associate Professor of Ceramic Engineering, Ohio State Univ.
Logan, Lloyd, Associate Professor of Gas Engineering, John Hopkins Univ.
Lovell, William E., Professor of Electrical Engineering, Univ. Saskatchewan.
McIlroy, Malcolm S., Instructor in Electrical Engineering, Mass. Inst. Tech.

Muckenhoupt, Carl F., Professor and Head, Dept. of Physics, Northeastern Univ.
Nettleton, E. B., Assistant Professor of Drawing and Descriptive Geometry, Carnegie Inst. Tech. (re-instatement).
Othmer, Donald F., Professor of Chemical Engineering, Poly. Inst. Brooklyn.
Pease, Edward M. J., Assistant Professor of Mathematics and Electrical Engineering, R. I. State College.
Riffenburg, Harry B., Associate Professor of Chemistry and Chemical Engineering, Va. Poly. Inst.
Rutledge, Philip C., Associate Professor of Civil Engineering, Purdue Univ.
Setter, Lloyd R., Instructor in Sanitary Engineering, New York Univ.
Stevens, Roe L., Associate Professor of Civil Engineering, Armour Inst. Tech.
Svenson, Carl L., Assistant Professor of Mechanical Engineering, Mass. Inst. Tech.
Tilles, Abe., Instructor in Electrical Engineering, Univ. Calif.
Tsai, Fang-Yin, Professor of Structural Engineering, National Tsing Uua Univ.
Vaile, Robert B., Instructor in Electrical Engineering, Univ. Mo.
Wadsworth, George P., Instructor in Mathematics, Mass. Inst. Tech.
Whiteside, George W., Assistant to Dean, Division of Engineering, Okla. A. & M. College.
Wiley, William Bradford, Educational Dept., John Wiley & Sons., N. Y. C.

MINUTES OF THE 45th ANNUAL MEETING, CAMBRIDGE, MASS.

June 28–July 2, 1937

The forty-fifth annual meeting of the Society for the Promotion of Engineering Education was held at Harvard University and Massachusetts Institute of Technology, Cambridge, Mass., Monday, June 28, to Friday, July 2, 1937, Harry Parker Hammond, Professor of Civil Engineering, Polytechnic Institute of Brooklyn, President. (President Hammond has since been elected Dean, School of Engineering, The Pennsylvania State College.) 1,586 members and guests were registered.

Conferences were held all day Monday and Tuesday and Wednesday and Thursday afternoons. The following conferences were held: Chemical Engineering, Civil Engineering, Coöperative Engineering Education, Drawing and Descriptive Geometry, Electrical Engineering, Engineering Economy, English, Graduate Study, Pre-College Guidance for Boys, Industrial Engineering, Machine Design, Mathematics, Mechanical Engineering, Mechanics,

Mining and Metallurgy, Physics, Professional Status and Employment of Engineering Graduates, Sections and Branches, Test and Comprehensive Examinations, Two-Year Terminal Program. (20)

The first general session was held at Harvard University on Wednesday morning, President Hammond, presiding. Vannevar Bush, Dean of Engineering and Vice President, Massachusetts Institute of Technology; Harald M. Westergaard, Dean-Elect, Graduate School of Engineering, Harvard University; and Carl S. Ell, Chairman, New England Section of the Society, welcomed the members to Cambridge. President Hammond responded. Karl T. Compton, President, Massachusetts Institute of Technology, addressed the Society, followed by President Hammond who delivered his presidential address—The Engineering Teacher. Treasurer W. O. Wiley read his report, which was his thirtieth report as Treasurer of the Society. Secretary F. L. Bishop reported the activities of that office.

The second general session was held at Harvard University on Thursday morning with President Hammond in the chair. The following papers were presented: "Practical Outcomes of the Study of Education since 1900," by H. W. Holmes, Harvard University; "Administering the Faculty," by W. O. Hotchkiss, Rensselaer Polytechnic Institute; "The Teacher and the Social Significance of the Engineer," by F. M. Feiker, American Engineering Council, and John S. Dodds, Iowa State College. Professor Dodds found it impossible to attend, so Professor Frank Kerekes of Iowa State College read his paper.

The annual dinner was held in the Walker Memorial Hall, Massachusetts Institute of Technology, on Thursday evening, President Hammond presiding. C. Frank Allen, Chairman of the Nominating Committe, presented the following names for officers and members of Council, all of whom, upon motion, were unanimously elected:

For President: S. B. Earle, Clemson Agricultural College
For Vice-Presidents: Karl T. Compton, Massachusetts Institute of Technology; F. C. Bolton, A. & M. College of Texas
For Treasurer: W. O. Wiley, John Wiley & Sons, Inc.
For Secretary: F. L. Bishop, University of Pittsburgh
For Council to serve three years:

G. F. Eckhard, University of Vermont
D. S. Elliott, Tulane University
F. M. Feiker, American Engineering Council
S. C. Hollister, Cornell University
F. B. Seely, University of Illinois
R. W. Sorensen, California Institute of Technology
A. H. White, University of Michigan

In accepting the office, President-Elect Earle said: "I appreciate greatly the honor that has been bestowed on me, but when I think of the work of the Society through the many years that I have been a member, when I recall the names of those who have preceded me as presidents, I am thinking a great deal more of the responsibility that I have than of the honor which has been bestowed.

"Every honor carries responsibility and the greater the honor, the greater the responsibility. In accepting this position, it is with a great deal of humility, recognizing as I do that there are many members of the Society who are much more worthy to perform this duty than I. I am glad that I will have the efficient Treasurer that we have had for thirty years, also the efficient Secretary and Assistant Secretary. I know the qualifications of the Vice-Presidents and I am glad to be a member of a team with them. I shall try to see that the traces with which I am bound are a little longer than those of the other two members so that I can lead a little but have them carry a great deal of the load.

"I am sure that if we work together as the members have in the past, Vice-Presidents, Council, Committees, and all members of the Society, we will be able to hold up the standards of the Society and to advance its interests a little during the year."

E. B. Roberts, Chairman of the Committee on Lamme Award, presented the name of Frederick Eugene Turneaure for the tenth Lamme medal. The award to Dean Turneaure "is for his influence upon the policies and people of the College of Engineering of the University of Wisconsin; for his conception of a university as a coöperative enterprise of scholars and disciples in which freedom and power to initiate is diffused, not centralized; for the spirit of steadiness and confidence he has engendered; for the harmonious and coöperative relations within faculty and between faculty and students that have matured under his leadership; and in recognition of the high place he has filled in engineering education and in public estimation not only in his own commonwealth but in the nation as well."

Henry M. Wriston, President of Brown University, delivered the address of the evening.

The third general session was held in Massachusetts Institute of Technology on Friday morning, Vice-President Crawford presiding. The Secretary presented the following amendments to the By-Laws of the Society.

The Council approves and recommends for adoption by the Society three new sections of the "By-Laws of the Society and Rules Governing the Council" to be numbered ninth, tenth and eleventh, respectively. These new sections are as follows:

Ninth. Any educational institution which has one or more of its curriculums accredited by the Engineers' Council for Professional Development shall be considered as "recognized" within the meaning of the constitutional requirement for active institutional membership, and no other educational institution within the United States or its territorial possessions shall be so considered.

Tenth. Any engineering degree-granting educational institution in continental North America, outside of the United States, shall be considered as "recognized";

(*a*) If one or more of its engineering curriculums have been accredited by an agency whose standards are adjudged by the Council of the Society to be not lower than those of the Engineers' Council for Professional Development, or

(*b*) If no suitable accrediting agency is available to appraise its engineering curriculums, but one or more of these curriculums are adjudged by the Council of the Society, upon satisfactory evidence, to meet standards not lower than those of the Engineers' Council for Professional Development.

Eleventh. Any Junior College or other educational institution giving instruction which is adjudged by the Council of the Society, upon satisfactory evidence, to be substantially equivalent to the first two years of one or more curriculums accredited by the Engineers' Council for Professional Development shall be considered as among those institutions "giving instruction in engineering" within the meaning of the constitutional requirement for associate institutional members.

(Present "ninth" section to be renumbered "twelfth." Additions or amendments may be made to those By-Laws at any regular meeting of the Society by a two-thirds affirmative vote of the membership present at the business session, provided that the additions or amendments shall have been approved by a two-thirds affirmative vote of the Council membership in attendance at the meeting, and shall have been recommended by that body for adoption.)

The following papers were presented: "Development of the Younger Engineer," by Warren K. Lewis, Massachusetts Institute of Technology; "The Engineer as a Servant of Society; a Problem of Education," by T. N. Whitehead, Harvard University; "Role of the Engineer of Tomorrow," by V. M. Faires, A. & M. College of Texas; "Looking Ahead in Engineering Education," by F. L. Eidmann, Columbia University; and the report of the Committee on Instructional Standards by Chairman H. S. Rogers, Polytechnic Institute of Brooklyn. Professors Chas. F. Scott, Yale University, E. S. Burdell, Massachusetts Institute of Technology, S. K. Barrett, New York University, D. C. Jackson, Massachusetts Institute of Technology, and H. B. Langille, University of California, discussed the papers and report.

The fourth and last session was held at Massachusetts Institute of Technology on Friday afternoon, Vice-President Sada A.

Harbarger presiding. Paul Cloke, University of Maine, discussed his paper, "Economic and Social Status of the Engineering Teacher." This had been published in the June JOURNAL OF ENGINEERING EDUCATION. There was discussion also by Chas. F. Scott, H. B. Dirks, Michigan State College, C. J. Freund, University of Detroit, P. S. Donnell, Oklahoma A. & M. College, and H. A. Everett, Pennsylvania State College.

Chairman W. E. Wickenden, Case School of Applied Science, presented the report of the Committee on Junior Colleges; Chairman A. R. Cullimore, Newark College of Engineering, the report on Orientation of Freshmen. These reports were discussed by President Hammond, Chas F. Scott, R. L. Sackett, Pennsylvania State College, and Robinson Abbott, Tufts College. F. A. Magoun, Massachusetts Institute of Technology, read his paper, "Training Engineers in the Art of Human Relations." M. C. Stuart, Lehigh University, presented the following resolutions from the Committee on Professional Status and Employment of Engineering Graduates and made the motion that it be received and placed on file:

WHEREAS it is the consensus of opinion of this meeting that the best interests of the recruiting industrial organizations as well as of the students themselves can thus best be served, *be it now resolved:*

(1) That every effort be made to remove any emotional pressure which may cause a boy to make a hasty or unwise selection of employment.

(2) That every effort be made for complete cooperation and mutual information between both the college placement office and industrial representatives themselves for the purpose of placing each man in his right job.

(3) That every industrial representative immediately furnish the college placement office with the names of students in whom he has become seriously interested as possible employees.

Chairman Harbarger turned the meeting over to President Hammond. The secretary read a resolution expressing appreciation of the reception accorded the Society by Harvard University and Massachusetts Institute of Technology and the entertainment provided. The Society unanimously adopted the resolution.

Meeting adjourned to meet June 27–30, 1938, at the A. & M. College of Texas, College Station.

REPORT OF SECRETARY, 1936–37

F. L. BISHOP

Membership.—We now have a membership of 2,582 individual and 120 institutional members, making a total of 2,702. We added 271 new members to the roll this year and lost 95, making a net gain of 176. We lost 21 members by death: H. Y. Benedict, A. Boyer, H. C. Bradley, A. T. Bragonier, G. M. Bartlett, H. N. Chinn, D. P. Craig, R. H. Fernald, J. A. Hall, W. A. Hillebrand, O. P. Hood, S. H. Lott, F. O. X. McLoughlin, R. I. Rees, M. C. Rorty, G. C. Shaad, R. G. Thomas, J. N. Vedder, R. B. West, Ed. Weston and A. M. White.

One of the striking facts in regard to this Society is the large proportion of members and guests attending the annual meetings.

Sectional Meetings.—The interest, attendance and enthusiasm of the sectional meetings warrants this Society in promoting this phase of its activity. G. W. Case, Chairman of the Committee on Sections and Branches, will report to you on this subject.

Committees and Divisional Activities.—President Hammond has frequently referred to this work of the Society as a coöperative effort. I am heartily in accord with this statement and I think that the excellent work which is done by our divisions and our committees is a perfect illustration of this coördination. These divisions and committees carry on the work during the year which involves the interest of a large number of individuals in the subject of engineering education. Many of their reports and conclusions have become working parts of the curriculum of different engineering colleges.

In order to coördinate more closely the work of conferences, a committee was appointed, Vice-President Crawford, *Chairman,* F. L. Plummer, *Executive Secretary,* P. H. Daggett, R. L. Sweigert and P. T. Norton. The work of this Committee appears in the program and speaks for itself.

An outstanding accomplishment for the current year was the publication of the report on graduate study under the direction of a committee headed by H. P. Hammond. The report was published as an official document of the Office of Education, Washington.

Last year the Committee on English presented the following resolution. Council granted the request and referred the matter to the incoming president.

That in the interest of a closer integration of the engineering curriculum, the Council of the S. P. E. E. is requested to authorize an investigation of the objectives of English instruction in engineering colleges and of the training of English teachers of technical students; and that the President of the Society appoint a committee consisting of technical, as well as English teachers, to conduct this investigation. (Committee appointed: E. C. Elliott, Chairman, H. L. Creek, K. O. Thompson, Harold Burris-Meyer, John Mills, W. O. Sypherd, J. L. Vaughan, A. M. Greene, O. J. Ferguson, John G. Bowman, H. S. Rogers.)

On behalf of the Executive Committee, the Secretary wrote to Dr. F. P. Keppel and on May 25, 1937, the following communication was received from the Carnegie Foundation:

We take pleasure in sending you, enclosed, a check in the amount of $2,500 drawn to the order of the Society for the Promotion of Engineering Education. This represents payment in full on a grant made by the executive committee of Carnegie Corporation of New York, May 12, 1937, through the Carnegie Foundation for the Advancement of Teaching, toward the work of the Committee on English under the direction of President Edward C. Elliott, of Purdue University.

This project has been given priority by the Carnegie Corporation over a large number of other opportunities of the same general character. In fairness, therefore, the present grant cannot be regarded as subject to renewal.

May we ask that you have the accompanying voucher signed and returned to this office for our records?

The Committee on English will meet with the Executive Committee at this meeting and present its plan for the coming year.

One of the important problems confronting the Society for some time has been that of institutional membership. A report will be presented to Council at this meeting by R. A. Seaton, Chairman of the Committee. This report contains recommendations which, if approved, will necessitate changing parts of the Constitution and the By-Laws.

The conflict of the annual meeting of this Society with other engineering societies has been one of the irritating factors each year. In order to eliminate as far as possible these conflicts, the policy was adopted by the Council of fixing the meeting places at least two years in advance. To carry out this policy more effectively the whole matter was referred to the Committee on Relations with Engineering Societies. In the January, 1937, JOURNAL OF ENGINEERING EDUCATION, the Committee addressed a letter to

Institutions expecting to invite the S. P. E. E. convention within the next three years should indicate their intention to do so to the Secretary at an early date in order that the time and place of our convention can be

adjusted to arrangements of other national engineering societies to avoid conflicts and to promote the convenience of members who may wish to attend the various June meetings. Such notice should include information covering the following items:.

1. Year for which the invitation will be extended.
2. Days in June of that year most convenient to the institution which expects to be host. Give dates of your commencement and of opening summer session for that year.
3. Capacity of hotels in city. Capacity of college dormitories available for the convention.
4. Membership of S. P. E. E. within 200 miles of the institution.
5. Advantages and supporting statements.

A report from this Committe will be received.

Summer Conferences.—Since the remarkable success of summer schools, there has been a demand for the re-establishment of these schools. This has been done to some extent through the establishment of what are called Summer Conferences. During the current summer the following conferences will be held:

Civil Engineering—at annual meeting.

Economics—Stevens Institute of Technology Camp, Johnsonburg, N. J.

Mechanical Engineering—at annual meeting.

Surveying—Camp Marston, Ranier, Minn.

Publications.—The matter of publications of the Society has become an increasingly difficult problem to handle. When the present secretary first took office, it was his practice to send circulars to a selected list of members asking for suggestions in regard to individuals who would prepare papers for publication in the JOURNAL. In other words, our main problem was to secure a sufficient amount of material to fill the JOURNAL OF ENGINEERING EDUCATION. Today the problem has become one of cost and selection of material. The problem may be stated as follows:

The present sum available ($6,000 to $7,000) to meet the cost of printing and distributing the JOURNAL will permit the publication of approximately 90 papers per year.

Let us look at the amount of material which is available. There will be presented at this meeting a total of 250 papers, everyone of which is sufficiently well prepared and important to warrant its publication. There are a number of important papers, perhaps 50, presented before sections of the Society. Each one of these warrants publication. In addition to these there are 25 to 50 papers submitted by members throughout the year which should be published. No publication committee has the wisdom to select only the best of such material. Again if we look at it from the point of view of the author who has spent a good portion of his

spare time for perhaps a year in accumulating material and preparing it for presentation, it would appear that such a paper should be published.

This very great increase in the amount of material available for publication shows a marvelous increase in interest, in time, and in effort devoted to engineering education. If this Society has accomplished nothing else, I am sure this one fact would warrant the work of the Society.

There have been a number of suggestions made in regard to the solution of this problem:

1. That we publish in the JOURNAL OF ENGINEERING EDUCATION one page abstracts of a large number of papers.

2. That we increase the number of pages of the JOURNAL. (This is impossible financially as the cost of the JOURNAL must be held within a certain narrow limit.)

3. That all papers be limited in length.

In addition to the JOURNAL OF ENGINEERING EDUCATION, there are publications by the New England Section, and by the Civil Engineering and Drawing Divisions, and by the Machine Design Clearing House. These are issued by the divisions under the name of the Society.

Engineers' Council for Professional Development.—The accrediting of engineering colleges, under E. C. P. D., has been carried on during the year. A list of accredited schools, issued by E. C. P. D., was published by the Society as a supplement to the October 1936 JOURNAL OF ENGINEERING EDUCATION. Further reports in regard to the progress of accrediting colleges will be made by H. P. Hammond who is one of the representatives of the Society on that Committee.

REPORT OF TREASURER, W. O. WILEY

STATEMENT OF CASH ACCOUNT

JUNE 19, 1937

BALANCE ON HAND—JUNE 18, 1936		$ 3,769.90
RECEIPTS:		
Current Dues	$11,409.40	
Back Dues	938.25	
Dues in Advance	203.00	
Sales of Publications	513.66	
Advertising	1,322.64	
Miscellaneous Income	40.05	
Receipt from sale of emblems	135.00	14,562.00
Total		$18,331.90

DISBURSEMENTS:

Cost of Publications	$ 6,661.49	
Cost of *Proceedings*	299.45	
Honorarium for Secretary	1,300.00	
Salaries—Secretary's Office	3,400.00	
Traveling expense—Secretary's Office	242.74	
Committee Expenses	145.65	
Printing, Postage, Office Supplies, etc.	1,086.68	
Expenses—1936 Meeting	683.40	
Expenses—1937 Meeting	177.92	
Dues—American Council on Education	100.00	
Dues—American Engineering Council	250.00	14,347.33
BALANCE ON HAND—JUNE 19, 1937		$ 3,984.57

NOTE—(1) In addition to the above balance, there is on deposit at the Forbes National Bank, Pittsburgh, Pa., in savings account 3809 the amount of $6,000.00 with accrued interest of $1,327.48 to June 1, 1937.

(2) There is also on deposit at the Mellon National Bank $2,500.00 for the work of the committee on English of the Society. This amount was received as a grant from the Carnegie Foundation for the Advancement of Teaching through the Carnegie Corporation.

INCOME AND EXPENSES STATEMENT

FOR THE YEAR ENDING JUNE 19, 1937

EXPENSE

Cost of JOURNAL	$ 6,661.49
Cost of *Proceedings*	299.45
Expenses—1936 Meeting	1,079.61
Honorarium for Secretary	1,300.00
Salaries—Secretary's Office	3,400.00
Printing, Postage, Office Supplies, etc.	1,086.68
Traveling Expenses—Secretary's Office	242.74
Committee Expenses	145.65
Dues—American Council on Education	100.00
Dues—American Engineering Council	250.00
	$14,565.62
Surplus for the year	229.01
	$14,794.63

INCOME

Current Dues	$12,212.40
Back Dues	338.25
Sales of Publications	513.66
Advertising	1,375.48
Sale of Certificates	135.00
Interest on Savings Account	179.79
Miscellaneous Income	40.05
	$14,794.63

Balance Sheet

June 19, 1937

Assets

Cash:		
Current Fund	$ 3,984.57	
Petty Cash Fund	300.00	
Life Membership Fund	800.56	
Benj. G. Lamme Fund	58.12	$ 5,143.25
Savings Account:		
Forbes National Bank—No. 3809		7,327.48
Benj. G. Lamme Trust Fund:		
Securities	4,947.00	
Cash (uninvested)	53.00	5,000.00
Prepaid expenses—1937 Meeting		177.92
Inventory		1.00
Accounts Receivable:		
Advertising	250.00	
Dues	700.00	950.00
Furniture and Equipment (Est.)		100.00
		$18,699.65

Liabilities

Life Membership Fund		$ 800.56
Benj. G. Lamme Fund		5,058.12
Prepaid Membership Dues		203.00
Accounts Payable (June Journal)		600.00
Surplus Account:		
Balance at June 18, 1936	$12,708.96	
Less—Amount due from Lamme Medal Fund (written off)	900.00	
Adjusted Balance—6/18/36	$11,808.96	
Surplus for present year	229.01	12,037.97
		$18,699.65

RELATION BETWEEN ENGINEERING EDUCATORS AND INDUSTRY*

By KARL T. COMPTON

President, Massachusetts Institute of Technology

I. Reasons for a Relationship between Engineering Educators and Industry

The reasons for this relationship are bilateral. A principal purpose of engineering schools is to train students for positions in industry, and conversely industry depends upon the engineering schools to provide its requirements for technically trained young men. Similarly many of the scientific and engineering concepts on which industries are based have their origin in the educational institutions, and conversely these institutions secure from industry not only many of their best tools and equipment for teaching and research, but also much stimulation and progressive thought from the industrial research and engineering staffs.

Further to illustrate this bilateral relationship, the following items are noted. Dr. Roger Adams in his presidential address before the American Chemical Society about a year and a half ago stated that university laboratories have supplied 95 per cent of the basic ideas on which present-day chemical industry is based. Conversely a considerable portion of the subject matter in the curriculum of chemistry and chemical engineering has to do with the chemistry of important industrial processes. The phenomenon of thermionic emission was intensively investigated for two decades in university laboratories and its major phenomena and theories established before it became an industrial product which is now basic in the communications and motion picture fields and in the control of electric machinery. Conversely it is from the industrial laboratories that there are now available thermionic devices of marvelous power and precision which give the universities some of their most powerful tools for further research. Similarly, the phenomenon of photoelectricity was investigated theoretically and experimentally by Hertz, Einstein, Millikan and hundreds of other university men before it became the photoelectric cell which underlies television, electric transmission of photographs and

* Synopsis of address before the 45th annual meeting, S. P. E. E., June 30, 1937.

operation of many practical devices. Reciprocally the electrical industry now supplies photoelectric cells for further research and, as in the field of thermionic emission, the industrial research staffs have added notably to both fundamental and practical knowledge of these phenomena. The cracking of petroleum and the hydrogenation of petroleum or coal were basically developed in university laboratories and are now of major importance in the fuel industry, which has in its turn greatly perfected these processes. The industrial urge to produce ever more efficient steam power plants led to the more accurate determination of the properties of steam at high temperatures and pressures by university laboratories and a governmental bureau, and the results obtained have in turn made possible the great strides in improved efficiency of power plants with accompanying saving of natural resources of coal and oil during the past decade. The liquefaction of gases and production of low temperatures have been pioneering fields of work in university laboratories, while in turn industrial firms have applied these results to many important chemical processes such as large-scale production of oxygen for welding. Reciprocally some of these companies are now supplying liquid air or liquid nitrogen to institutions like M. I. T. and Harvard to aid them in further scientific research.

It is an interesting question to consider which group leads,—the engineering and scientific school on the one hand or industry on the other. The answer is that the lead is taken now by one and now by the other, sometimes in one field and sometimes in another. In general the schools tend to lag behind industry in the art and to lead industry in the theory or the science on which the art is based. Sometimes this order of leadership is reversed. It is partly accidental, depending on the location of the men who happen to have the new ideas. One thing is certain: No man in an engineering school is likely to make a direct contribution to an industrial art unless he is in some way directly associated with the problems of industry. The indirect contributions of the university man, however, and those which are frequently most important in the long run, may be made without contact with or knowledge of industrial problems, as the following illustration will show.

If a group of engineers a century ago had been asked to devote themselves to the problem of increasing the efficiency of illumination they would undoubtedly have turned their attention to a study of candles and oil lamps. However, the great advance in illumination came from the work of such men as Faraday, Henry, Edison and Thomson and Langmuir in the field of electricity.

As a matter of fact, neither the engineering school or industry could exist without the other. If the engineering schools were

stopped, industry would have to start schools of its own else it would starve to death. If industry should stop, the schools would choke to death through inability to dispose of their product. Thus the relationship is mutually advantageous and must be maintained.

II. Methods of Maintaining Relationship between Engineering Educators and Industry

On the part of the teachers the relationship is maintained by (1) the acquaintance secured through journals, plant visits and contacts in professional societies; (2) by research on problems of the industry; (3) by acting as consultants for the industry; (4) by part-time employment in industry, as in summers or during leaves of absence or simultaneously with teaching duties.

On the part of industry this relationship can be maintained (1) by acquaintance of industrial staffs with educators and their institutions through professional societies, journals and visits to universities; (2) by giving personal help to universities, as through lectures, service on advisory committees and maintenance of contact with university research projects; (3) by financial help to universities, as through fellowships or grants of funds for research, especially if the industrial organization maintains close contact with the progress of these fellowships and investigations; (4) by occasional exchange of staff members between industry and an engineering school.

Although there are difficulties, I believe that there are decided opportunities in the last of these suggestions. Several years ago the Executive Committee of M. I. T. authorized annually a staff exchange arrangement with any other institution for each of its several departments. The idea was to promote exchange of the best ideas in education or administration. While some advantage has been taken of this authorization, I regret that it has not been more widespread. I believe that the plan could advantageously be extended as between engineering or scientific departments and the research or operating branches of industry, although there are obvious complications involved.

III. Administrative Problems Involved in Maintaining Relationship between Engineering Educators and Industry

There are certain dangers which must be guarded against in promoting relationship in the directions outlined above. For example, the dangers inherent in industrial consulting practice and part-time employment by teachers are well recognized. Such practice may be a powerful aid or a serious detriment to the institution, depending on the spirit in which it is done. These dangers

include the following features. If consulting work is counted on to supplement salaries it tends to depress salaries and frequently to introduce "pot boiling" activities of the staff which neither advance the art nor improve the powers or professional status of the teacher. Consulting work may lead to a neglect of academic duties and a tendency to put them into a subordinate place, to a loss of respect for the art of teaching and to considering an academic post as an insurance policy rather than a life work. The lure of the "almighty dollar" may warp the perspective and dull the idealism which is the inspiration of great teachers. Large consulting activity by senior members of the staff may be demoralizing to the younger men who, by example, may gain the impression that academic duties are of inferior status. Undue consulting activity by some members of the staff may create jealousy and feeling of inequity on the part of other staff members whose work is equally important and creative and active, but lies in fields of pure research or inspiring teaching or valuable administration in which the extra emolument is lacking.

Similarly there are certain dangers in very close contacts by representatives of industrial organizations with educational institutions in the fields of science and engineering. One of the most serious of these dangers arises from the possibility of patent complications which lead to distrust and inhibitions. This is also a major bar to any plans for exchange of staff between research laboratories of industry and the laboratories of engineering schools. It is a great pity that this is true but the fact must be faced.

In spite of all these dangers and complications the importance of close relationship between engineering educators and industry is so great that methods must be perfected for stimulating this relationship and minimizing the dangers and difficulties inherent in it.

IV. Practical Administration of Problems Arising from Relationships between Engineering Educators and Industry

As regards the dangers inherent in consulting and other industrial employment of teachers by industry, there are two aspects of administration through which dangers can be minimized and advantages maximized. The first and most important is to have a morale and idealism on the part of the staff which is secure if the staff have a sincere desire to avoid the dangers and secure the benefits, and especially if they place the welfare of their institution ahead of their personal welfare financially or otherwise. The second aspect of administration involves the adoption of a well thought out institutional policy with which the staff are in agreement. These two aspects of course are closely interdependent.

Our thought and progress in this matter at M. I. T. may be summarized in perhaps four stages, as follows:

1. Prior to the close of the war, so far as I am aware, there was no definite institutional policy regarding industrial consulting work by members of the M. I. T. staff. Undoubtedly such work took its normal trend with various individuals and perhaps the problem at that time was not a serious one.

2. Following the close of the war there was a time of financial stringency in which was developed a so-called "Tech plan" of cooperation between M. I. T. and industry, whereby various industrial organizations contributed financially to the support of the Institute, while in return the Institute established a placement bureau especially for the contributing industries, opened its laboratories to industrial research for the industries and undertook to facilitate the formation of consulting arrangements for its staff. This plan had several advantages. It enabled the Institute to retain its staff through a difficult financial period, it promoted closer contacts between its staff and important industries, and it undoubtedly performed some valuable services for the industries themselves. On the other hand, the plan tended to accentuate the dangers mentioned above and also was probably responsible for a considerable time lag in the adoption of a more satisfactory scale.

3. In order to meet some of these difficultes in 1931, simultaneously with an increase in salaries, there was adopted a "pooled contributory plan" whereby 50 per cent of outside earnings by members of the staff for work performed during the academic year was turned into a common pool called "The Professors Fund," from which appropriations were made for the benefit of the staff on recommendation by a committee of the professors themselves. The principal objectives of this plan were first, to emphasize the principle that a professor on full-time appointment owed his first and reasonably full-time service to the institution; second, to permit a somewhat closer equalization of financial return as between the two groups of equally able, valuable and hard-working professors, the one whose extra work brought in outside remuneration and the other whose extra work was devoted to research or administration or a particularly high quality of teaching; third, to promote the ideal that the institution was a coöperative enterprise rather than an aggregation of individuals who were independent except for certain assigned duties.

Due to the good spirit with which this rather radical plan was accepted by the staff it operated more satisfactorily than its most enthusiastic advocate might have anticipated. It accomplished a great deal in the direction of its objectives. It had, however, an undesirable element of coercion and a rather "communistic"

aspect which was not relished by at least the more individualistic members of the staff. Consequently after three years of operation, during which time a much more adequate administrative plan of deans and heads of departments had been established and during which the basic objectives of the plan had received general acceptance by the staff, a moratorium was declared on this "pooled-contributory plan" in favor of a less formal plan based entirely upon the sincere acceptance of certain principles by the staff and their enforcement by the heads of departments and deans.

4. This plan can best be described by quoting the statement of "Principles Concerning the Obligations of Full-Time Members of the Staff" which was unanimously accepted by the faculty and approved by the Executive Committee of the Institute.

1. The professional activity of every full-time staff member should be primarily dedicated to the service of the institution, and to the public welfare.

2. Every full-time member of the staff should devote reasonably full-time effort to activities within the categories which follow:

(1) Teaching the students of the Institute, in formal classes and laboratories, and informal groups and conferences.
(2) Preparation for such teaching.
(3) Study for the purpose of keeping abreast of the profession, and for improving teaching skill.
(4) Administrative and committee work in the Institute, and professional service to the Institute on its internal problems.
(5) The writing of professional papers and other serious contributions.
(6) The writing of texts which are written principally for their value to the profession.
(7) Activities in professional societies, of such nature as to advance the profession.
(8) Consultation with colleagues for the purpose of advising them in their problems, especially counsel to younger staff members.
(9) Services to sister educational institutions, to governmental bodies, and to institutions privately maintained for the public benefit.
(10) Representation of the Institution before public in lectures and in similar ways.
(11) Supplying counsel and guidance to students in worth-while extra-curricular activities.
(12) Research of all forms carried on to advance knowledge, or improve the art, and thus of immediate or ultimate public benefit.
(13) Consulting service to and research for industry, of such important and dignified nature that its carrying on enhances the prestige of the institution, vitalizes teaching, and provides helpful contacts for the student.

3. Activities other than those above mentioned and those that are recreational, should be worthy of the serious efforts of a member of the staff of this Institute. They should not be indulged in to an extent that inter-

feres with the full discharge of the individual's primary duties to his institution.

4. It is the duty of each staff member to keep his department head advised of the general scope of his activities, particularly with respect to any major commitment for service to industry; and to be guided by the counsel of the administration in ordering his activities, so that his services may be of maximum value to the institution and properly coördinated with the activities of his colleagues.

5. The administration's decision on all salary adjustments should be based on the principle that salaries paid to staff members shall be in proportion to the value of their total contributions, and should recognize that this total is affected, not only by the extent and nature of the activities, but also by the effectiveness with which they are pursued.

Under this regime I think it can fairly be said that the staff of the Institute have coöperated splendidly, that the objectionable features and dangers of outside consulting work have been largely avoided and that its advantages have been retained and maintained on a high plane.

Similarly, with respect to the complications from the side of patents which are involved in close contact between staff members and industry, the problem has been greatly clarified and the difficulties alleviated by the unanimous adoption by the staff and Executive Committee of an institutional patent policy which serves as a guide in the flexible handling of the numerous individual cases which arise. This patent policy was adopted after five years of study by a faculty committee on patent policy headed by Dean Bush, and with knowledge of procedures of other educational and altruistic organizations.

The first step in developing this patent policy was a general agreement on the principle that inventions resulting directly from a program of research financed entirely by the Institute, should be the property of the Institute, and the achievement of the staff member making an invention should be recognized through salary and promotion, just like an achievement in any other aspect of the Institute's activities—in teaching, research, administration, or industrial coöperation. Similarly inventions along lines unrelated to an Institute program of research, and to which the Institute contributed nothing substantial in funds, facilities or time, are the exclusive property of the individual producing the invention.

Now a further step has been taken. An agreement has been entered into with Research Corporation of New York whereby this organization will handle all legal and commercial aspects of inventions assigned to it by Institute inventors. The Patent Committee of the faculty, however, remains in existence and reviews inventions brought to its attention by the staff. Whenever an invention falls within the classification of the

statement of patent policy, and appears to be of substantial potential importance, the Committee recommends to the inventor that he enter into an agreement with Research Corporation providing for patenting and commercialization. In order effectively to carry out its part in this arrangement, Research Corporation has set up a Boston office, which is in charge of Carroll L. Wilson, '32. Inventions so far handled by the Committee itself, about 30 in all, are now being transferred to Research Corporation to be handled in accordance with the new arrangement.

The completion of these arrangements has enabled the relationship of the inventor to the Institute to be worked out more definitely than has been the case before. Since the first close attention was given to this subject, it has been the announced intention of the Institute to recognize those advances in knowledge on the part of the staff which take the form of invention as legally defined, on exactly the same basis as it recognizes scientific contributions to knowledge which do not come within this category, namely, by those advances in salary and rank, and by that support of staff research activities, which are due to those whose contributions to the welfare of the Institute take this specific form. A policy based on these principles has constantly guided the administration. In addition the Committee has felt it to be equitable that an inventor should participate directly in the proceeds of his invention, even when it arises immediately from an Institute-supported program of research. Accordingly, in the contract which it now recommends both in connection with new invention and to replace agreements under which it has handled inventions to date, there is included a provision whereby the inventor participates directly in the gross income. The balance, after expenses, is to be divided, and Research Corporation will turn the principal part of such balance over to the Institute.

The whole matter has always rested, and continues to rest, upon a basis of voluntary coöperation on the part of members of the staff. Except in the case of certain industrial research projects, the Institute does not ask its staff to enter formal agreements in regard to patent assignment, and does not intend to do so. There has been no case, however, in which any individual inventor has disagreed with the findings of the Patent Committee as to what is considered reasonable procedure in individual instances. Staff members have cordially accepted the judgment of a committee of their colleagues.

In all steps taken in the last five years in regard to the commercialization of patents, the Committee has had the primary objectives of making inventions available to industry and the public on a reasonable basis, of avoiding conditions which would lead to the unnecessary exclusion from the use of an invention of any manufacturer who qualified to use it, of avoiding situations likely to lead to litigation, and of maintaining the cordial relationship existing between the Institute and the public. If there is substantial income from this source in the future, the Institute will use it for the advancement of its broad objectives: the advancement of science, aid to industry, and education of youth.

Relations with industry in this connection have been excellent. It remains true that when a company contributes the full support of a re-

search within Institute walls, special agreement may provide for the assignment to that company of inventions resulting therefrom. Such closed or confidential research projects are now rare, largely because staff and facilities are occupied primarily with a broader type of coöperative research with industry, to which both the Institute and the industry contribute. Such research becomes essentially a part of the educational procedure as a means of training advanced students, and a part of a stimulating atmosphere of advancement. The agreement for this type of coöperative research will also provide, ordinarily, for special handling of any inventions which may arise therefrom. A third form of relationship with industry occurs in the consulting activities of staff members. The handling of inventions arising in such connections is provded for in the usual code of ethics of consulting engineers. Finally there is the case where, entirely without formal agreement, a commercial company contributes substantially to the work of a particular laboratory, from which arises an invention of interest to the company. The Patent Committee has cared for this contingency by taking the stand that in such cases the contributing company is entitled to a license for its own purposes without further consideration, and it will so recommend when the facts of the situation warrant.

More important than the formalities of the situation, however, is the general attitude of industry. This is indicated by the record. Since the patent policy went into effect, there has been a continued and increasing coöperation between industry and the Institute staff, both in formal ways and in those informal contacts which are helpful and stimulating to both. Part of this is no doubt due to the fact that the industrial and institutional research men now visit one another's laboratories without embarrassment, realizing that in both cases there is provision for prompt and systematic handling of the subject of inventions as they arise.

The effect of a patent policy upon the Institute's relationships with the public has had long and serious attention. It has been questioned at times whether the existence of such a policy might not render individuals less willing to support Institute programs of research. This has certainly not occurred; support of research programs has been generous, and not one of the contributors has criticized the presence of the system. Furthermore, the present arrangement is entirely consistent with the general principles unanimously recommended by the committee on patent policy of the National Research Council after long study and consultation with leaders of thought and administration in the universities, professions, research institutes, and industry.

The Patent Committee has, from the outset, been keenly alive to the dangers which are inherent and cannot be truly avoided in our institution where important inventions arise inevitably. The dangers are avoided least of all by ignoring the presence of the problem. This is the negative aspect of the subject. The positive side is much more important. A smoothly operating, equitable system will facilitate the development and utilization of these inventions and thus implement a decidedly potent aspect of the activity of the Institute staff by bringing the results of its scientific and technical research to the furtherance of industry, and thus increasing the standard of living of the people of the country.

Finally, a most important aspect of industrial coöperation is the maintenance of some organization or division through which can be routed the great variety of miscellaneous industrial contacts with which every engineering school is involved. These contacts are of great variety, including inquiries regarding personnel, questions as to where this or that technical work can best be performed, requests for consultants or for assistance in specific industrial problems, contracts for industrial research, letters from inventors, and the like. To this end an organization like the Division of Industrial Research at the University of Michigan, of the research foundations of Wisconsin or Purdue, or the Division of Industrial Coöperation at M. I. T. are of great advantage both for the maintenance of industrial coöperation and for the relief of the staff members from continual interruption of inquiries of an unimportant nature.

V. Some Opportunities for Improving the Relations between Engineering Educators and Industry

1. The industrial demand for first-class young men and the insistent inquiries as to how such men can be secured gives a major point of contact between engineering educators and industry. A couple of weeks ago the president of one of our largest chemical firms said to me, "We simply cannot find a supply of able, well-trained organic chemists. The demand is most urgent. Have you any suggestion as to how we can meet the demand?" I have heard similar expressions from industrialists in the fields of chemical engineering and metallurgy, and undoubtedly the same situation will exist throughout the whole field of technology. There are certainly some ways in which industries could assist the engineering schools in providing the answer to this type of question. Among these ways I would suggest the following:

(1) Industries should assist universities in maintaining high grade educational staffs. I know of a few cases in which a forward-looking industry has assisted financially in enabling an outstanding teacher of young men to stay in his teaching position in spite of attractive industrial offers elsewhere. Such investment has been well paid through the maintenance of a continual flow of well-trained young men into these industries. On the other hand, I know certain fields in which the industries have largely drained the educational institutions of the effective men on their teaching staffs, and the industries are now suffering the results of this short-sighted policy and are wondering why the universities are not turning out more well qualified men in these fields. I should therefore put as a first importance in any coöperative re-

lationship, financial assistance by industry whereby universities may maintain the outstanding key men in their teaching positions.

(2) The fellowships and research grants which are made by several industrial organizations are certainly helpful in the training of well qualified young men who will have a natural interest in accepting employment with the firm which supplied the fellowship. I believe that this plan also can be widely extended.

(3) Contracts between an industrial organization and a university, whereby the university carries out some investigation for the benefit of the industry, form a mutually advantageous method of coöperation. Under these contracts the staff of the institution has an opportunity for professional development and close contact with the industry, and usually some high grade advanced students find an opportunity for training in research. The industrial organization not only secures the results of the research but also has an opportunity for close contact with the advanced students who may be potential employees, and also contact with the staff of the institution through whom future employees or future research projects may be routed.

(4) Of all the methods for maintaining relationship, I believe there is none which is more effective than the coöperative training courses, if these are well supervised both by the educational institution and by the industry. These courses not only provide an excellent type of training which combines theoretical and practical aspects, but it also permits the students to secure a first hand opinion of a prospective employer and enables the personnel officers of the coöperating companies to form an accurate opinion of the qualifications of prospective employees. I recently saw the figures regarding employee turnover in one of the large companies which operates a coöperative course, and it was found that the turnover among employees who had previously been coöperative students was so strikingly less than the turnover among other college graduate employees as to indicate that the costs of a coöperative course had been regained many times over by the company in its savings on the waste of turnover.

I believe there is a further opportunity for improving the relationship between engineering educators and industrial organizations through a proper type of educational publicity. What I have in mind is well illustrated by the report made before this Society several years ago by Director Spahr of the General Motors Institute, whose survey showed that graduates of engineering and technical schools are many times more likely to be found in positions of executive responsibility in industry than are graduates of other types of colleges, or non-graduates. I have found these figures extremely effective as I have discussed or argued the values

of engineering education with prominent people, many of whom have suffered under the delusion spread by that catch phrase, "You will always find an engineering graduate at work but you will find him working for some one else." A second example of proper type of educational publicity was a study of the progress in industry of the graduates of M. I. T.'s course in Business and Engineering Administration over a ten-year period. This survey indicated the trend in type of employment and in salary and showed in a very convincing way that the graduates of this course in very predominant proportion really worked into the types of industrial administration for which the course was designed.

I know that Purdue University has used very effectively the results of its survey of the progress in the positions made by its graduates, and undoubtedly some other institutions have done likewise. We are planning next year to carry out such a survey for all the departments of our institution to cover a period of ten years and perhaps more. Perhaps other institutions may be interested in doing this at about the same time, and if so the consolidated results might give a very interesting picture of the value of engineering education as measured by its results.

Perhaps such a survey would be an interesting project for the S. P. E. E. to sponsor. Obviously the Society itself could not conduct the survey, for this would have to be done by the institutions for their own alumni. It might be, however, that the Society could stimulate interest in such a survey and secure at least a small group of representative engineering schools to conduct such a survey during the next year or two. I believe that the results of the survey would serve as a guide to the respective institutions in dealing with a number of questions of internal policy and administration, and that the results generally would be an effective method of convincing the public and particularly industry of the values of engineering training.

THE TEACHER AND THE SOCIAL SIGNIFICANCE OF THE ENGINEER*

By FREDERICK M. FEIKER

Executive Secretary American Engineering Council

May I put my first general conclusion at once. It is evident that you would not have put this subject on the program and would not have emphasized it so often in other papers on this program if it had not been obvious that no group of leaders of thought and opinion has a more difficult task than the teachers of engineering and allied subjects. Hand in hand with that generalization is the fact that because of the specialized relation that teachers of engineering have to students, to industry and to the public, no other group has any greater responsibility for initiative and leadership.

We live in a time when emotion seems to have taken the place of logic, when technology, economics and sociology are mixed not only with political economy, but with politics and when the very bulwarks of what we have called our American system of government are under fire. Often in these times our national leaders, whether in industry, in economics, in the social sciences, or in politics seem to be working at cross purposes with no common goal. Over and over again during the series of Commencement addresses just closed, orators have stated to the young people who are graduating that the future of our democracy rests with them. This may be one form of "passing the buck" by a generation confused by the issues of the day, but we know at any rate that many of the so-called solutions of our present problems will not be finally tested for another generation. Again and again we read that the burdens of costs and the administration of the experiments which this generation is trying in such fields as social security, labor management, centralized control of agriculture and industry, the planned development of our raw materials and other national resources, all these will rest on the shoulders of our children, rather than upon ourselves. And since next to parents, teachers are the guides and pilots of our young people it goes without saying that it is our deep responsibility to think clearly, to speak the truth as we see it, to hold ideals of character and of purpose high—in short, to interpret our particular subject against the background of deeper purposes in these changing times.

* Presented at Cambridge meeting of S. P. E. E., July 1, 1937.

General Background of the Present Times

In order to place the teacher against the background of the social problems of the day which have resulted in part from the work of the scientist and the engineer, it may be well to review under three or four broad headings the interrelation of the engineer with questions of economics, of social relations and of government. The literature of technology and of our scientific and mathematical subjects has been widely developed during forty years. One of the first general notes to strike is that we are just in the beginning of developing a literature which covers that twilight zone between engineering and the social sciences. We greatly need interpretive literature in this field, not only for the clarification it would bring to some of these overlapping problems but for the wider understanding and the logical discussion of many of the problems by both engineers and economists and public representatives. It is significant that during the last five or six years particularly in our professional societies, in our engineering colleges and in our technical and general press, an increasing proportion of time and thought is being spent in this field, so that the teacher now has some sources of inspiration or suggestion from the literature of the times. Nevertheless, much that has been published by the economist, by the sociologist, by the public officer, needs re-interpretation if industry is to receive the benefit of such new philosophies. I sometimes think of industry and the men responsible for determining business policies and meeting payrolls in their own concerns, as standing on a shelf half-way down a precipice. A false step and they go over. Meanwhile, up on the top of the canyon, economist and social scientist are letting down theoretical ropes which do not quite reach the poor business man. It has been my idea that the engineer might find some way to add a few feet to these theoretical ropes so as to put into practice some of these so-called new social objectives.

Engineers are not alone in thinking of this as a practical opportunity. Harold G. Moulton, President of the Brookings Institution of Washington, in an address before the Schenectady Section of the American Institute of Electrical Engineers, stated, "Engineering is concerned with the application of scientific knowledge to the processes of wealth production. Economics is concerned with the basic resources and factors upon which wealth production depends and with the forces and institutions which influence or control the operation of what we call the economic system. It is readily apparent therefore, that the advance of engineering has a vital bearing upon economic problems. In turn, though perhaps less obviously, the operation of the economic system largely determines the rate at which new engineering discoveries may be applied in the actual production of wealth."

Dr. Moulton then goes on to show how the conception of natural law developed and then says, "All this it will be seen constituted a theory of economic and social evolution or 'a science of society.' New conceptions resulting from discoveries in the field of natural science came in time to be the foundation of social science. Moreover, the practical application of scientific discoveries through the processes of production gave to the business organizer an ever-expanding scope for his enterprise. One needs cite only the influence of steam, electric and gasoline power on transportation development to indicate the significance of science in broadening the area over which business enterprise can successfully operate."

Dr. Moulton continues, "In conclusion I would summarize the fundamental requirements for sustained progress in the following terms: There must be constantly increasing efficiency in production on the part of both labor and capital. Only by everlastingly improving technical processes and lowering the costs of production can we obtain progressively higher standards of living. To try to accomplish this result in any other way means simply tugging in vain at our collective boot straps.

"As efficiency is increased, the benefits must be broadly disseminated among the masses by means of high wages, low prices, or a combination thereof. This is essential for a double reason:

"First, it is a fundamental requirement for social and political stability and the well-rounded growth of a democracy. It is doubtful indeed if any economic or political system can permanently maintain itself unless it does maintain the goal of the greatest good for the greatest number.

"Second, a broad dissemination of the benefits of technical progress is necessary to provide the market demands for an expanding industry. Under our capitalistic system we produce to sell goods in the market. If we increase capacity to produce without correspondingly increasing the capacity of the masses to purchase, we simply reach an impasse. Production schedules have to be restrained, with an accompanying retardation of the rate of economic progress. Industrial growth, development, progress, require the expansion of consuming power step by step with the expansion of producing power. To put the matter in the simplest possible terms: Growth in the economic organism like growth in any other organism must proceed from the deepest and broadest possible rootage. It must rest on the expanding well-being of the entire population."

While the economist may not always visualize, as does Dr. Moulton, the interrelation between engineering and economics, it is in the field of the social relations expert, or the human relations investigator, that we have an even less perfect understanding. Yet, it is a fact, and I think Dean Sackett of Pennsylvania State College was

the first engineering teacher I heard put it into words, that the only real contribution made on a scientific basis in the field of human relations is that made by the engineer in his concept and methodology of scientific management. And far from being inhuman, as Elliot Dunlap Smith of Yale has pointed out in studies made in the textile industry, the so-called "stretch-out system" can be installed in such a way as to contribute to the happiness and welfare of the workman. In other words, a combination of engineering principles and understanding of human nature can be made to contribute as greatly to so-called social objectives as reams of "literature of hope" which have and probably will continue to be written on this subject.

Then we have a third field of the engineer's relation, namely that of his contribution to government. Dean Vannevar Bush, of the Massachusetts Institute of Technology, is one of the latest to relate the engineer to government. In his paper delivered at the summer convention of the A. I. E. E. in Milwaukee in June, 1937, he made a stirring appeal for a united profession on government questions. In his opening paragraphs he says, "There has been much attention paid to equipping and speeding up the conveyance in which civilization rides and comparatively little devoted to safety devices." To quote further, Dean Bush conceives the engineer's place as a part of the great professional classes. He says:

"Standing aside from the industrial system, and yet intimately connected with it, are the great professional classes, of which the engineer forms a part. It will be well for us to pause and examine what it is that renders a man a member of this professional group. It is much more than the possession of special knowledge, although this is a necessary attribute. The skilled machinist possesses special knowledge, as does indeed the man who owns and manages a machine shop, yet neither is thereby constituted a professional man. It is more than the nature of the source of income. True, many professional men, physicians and lawyers especially, derive their income from fees from clients. Yet a clergyman is usually on a salary. The majority of scientists are similarly paid by universities and scientific institutions. The great proportion of engineers are regularly employed by industry on a salary basis. Definite association with a specific organization on a salary basis does not bar a man from rightful membership in the professional class. The distinguishing characteristic is the possession of a philosophy and a point of view. The true criterion lies in the basis of motivation of the individual."

The Teacher and His Problem

Having generalized on what we may call the "social significance of the engineer" part of my subject, may I now delicately discuss

the teacher and his problem? Here, I admit at once my amateur standing. I did for two successive winter terms, serve as a minor member of the teaching staff of the Graduate School of Business of the University whose hospitality we share today. I did live at the old Colonial Club and learned that a history professor, even at Harvard, might be as crotchety as an engineer early in the morning, before he had his coffee, and that there seemed to be competition between professors in the recognition of learning, fully as keen as in the publishing business with which for several years I was connected. Nevertheless, what I have to say about teachers, must be said primarily, if not from full knowledge as a teacher, at least with a fellow-feeling as an educator. As an editor for many years in technical fields, I believe I can sympathize on a common plane, with those who profess to tell the other fellow "how to do it." Certainly, the technical editor, shares in common with the teacher of engineering, the problem of educating leaders and prospective leaders of industry as to the interrelationships between technical advance and the social and economic questions of the day. Engineering teachers share with engineering editors also, the responsibility of being a part of the industry or profession they serve, and of having the opportunity to step out of the procession once in a while and watch it go by, in the hope of seeing the direction it is going, and of steering it toward what seems to be its real or true objective. Anyone who thinks this is an easy job, whether he be a teacher or an editor, or even the secretary of an engineering organization, has another guess coming.

I suppose the "Relation of the Teacher to the Social Significance of the Engineer" becomes realistic when we examine the job we are trying to do. It boils down to this, "The Training of Men For Industry and Life." What, therefore, your association is really suggesting by this subject is, "What can we do in the four years we have at our disposal to relate, in a boy's mind, what he is learning in science and technology to the present and future social and economic life of his country?"

This again is a subject for experts and upon it many experts have spoken. Some stick to the idea that the study of science and applied engineering in itself is a cultural preparation for life. Another group build their educational philosophy on a wedding of the natural sciences and mathematics with history and the social sciences.

President Doherty of the Carnegie Institute of Technology, in a recent address on engineering education, puts the latter case this way: "Unquestionably, we must start from the premise that competent citizenship is the first responsibility, and that the more the individual's educational opportunity is extended, the greater this

responsibility. This aspect of educational philosophy, although recognized here and there, as at Columbia, has yet come to be almost wholly overlooked in higher education. Great credit and gratitude are due that portion of educators who preside over primary and secondary education for their attitude in this connection. But we cannot let the matter rest at that point. Competency as a citizen requires more than a preliminary knowledge of the origin, purpose, and form of our government, the early disposition to coöperate and accept majority opinion, and the other attitudes cultivated in the first levels of education. It requires, as well, especially of the better minds that have had the privilege of higher education, an understanding of principles and forms of governments, a cultivated ability and attitude to weigh, with respect to the best interests of American democracy, the complex issues that arise; and some feeling of obligation to decide intelligently and give support to the decision. Because, if I may be pardoned for reminding you, our experiment in democracy rests four-square upon the assumption that the citizens themselves are competent to settle issues wisely. My question is: If most of those including engineers, whose minds are trained to think carefully are to be directed merely to enterprises that create still more of the social and economic complexities that confound us, who will do the thinking in our community and national life? For, after all, are we not interested quite as much as a nation in where we are going and taking our children, as in the thrill and fascination of the journey itself? If we are not interested as trustees of American freedom, then are we not interested as parents of our children? I can answer the question. If more professional people, who presumably are trained to think do not take interest in these matters, then the future talent exercised upon the problems of state will be just what it has been, and the end result is clear. The American experiment is too great, its ramifications too complicated, its growth in complexity too rapid, its values too precious to be guided by emotion and selfish interest. A successful issue of the experiment demands guidance that is based on intelligent, dispassionate study. And this cannot come from a mere handful of men; it must, by the very nature of democracy, come from large numbers. If we are to endure as a free nation, we must not forget, as we certainly have done, the fundamental philosophy of 1776 that competent citizenship is our first responsibility, and this responsibility proportionally greater as the educational privilege is extended.

"If this point of view is once again seriously accepted, then new attitudes are implied in higher education and business. Professional education must devote to this end more of the precious time in its programs, and this means either an extension of the programs

or that industry and business must be willing to accept graduates with less specialized training than they now have."

President Doherty then goes on to say that he conceives two stems to a technical education—one technical, one social, and that the first critical question is, "What is to be the distribution of time between the technical and social phases of the curricula?" With the development of this type of engineering curricula, you are all familiar, but there is one point which President Doherty makes, which I believe has a special place in this brief review and that is that the social stem, as he calls it, should be continuous. The purpose is to build up a habit of mind; to create a desire to be broadly educated, to cultivate a stem that will grow after graduation.

May I refer here, to one of the enthusiasms that I shared with the late General Rees, for the post professional training of the engineer, under the guidance of the Committee of ECPD, of which he was Chairman. Our visits to a number of communities indicated that the junior engineer was definitely interested in continuing his education. We agreed, moreover, that the work of an organization like the American Engineering Council can never reach its true objectives until it is supported intellectually, not only by the relatively far sighted few who have envisioned its usefulness and work for its fulfilment, but by a body of young professional men interested from the beginning of their professional lives, in what Professor Doherty calls the social stem of the two stemmed educational curricula.

This is not the time or place to develop this idea further, but it seems to me to be so definitely a part of the engineer's future relation to the social significance of his profession, that I have made a brief excursion into it. I cannot fail to mention however, the significance of Professor Edmund D. Ayres' report to his faculty at Wisconsin on the "Next Step in Engineering Education." It suggests a curriculum in great detail.

I will sum up this viewpoint on curricula by a further liberal quotation from President Doherty's paper:

"I recommend," says he, "(1) a clear historical understanding of the parallel growths of science and engineering, on the one hand, and social customs, relations, and institutions, on the other, and how these have reacted on each other. In other words, an historical perspective of social evolution, especially since the advent of the machine. (2) The ability to read purposefully in order to make a critical analysis of a problem involving social and economic elements, and arrive at an intelligent opinion about it. The ability to analyze technical problems does not, as sometimes assumed, imply an ability to analyze these others. (3) The ability to organize thought logically and with purpose. (4) The capacity to use the English language and thus express those thoughts effectively. (5)

Appreciation of English literature. And (6) a continuing interest in all these matters and thus the desire to become educated."

Materials For Teaching

Next to curricula come materials of teaching. Here, I should like again to be pardoned for reverting to the first person. In the summer and fall of 1933, I was invited to inquire into the educational method and procedure of the eleven institutes and institutions, which train men specifically for the textile industry. Four of these schools are located in New England, one at Lowell giving a degree of Bachelor of Textile Engineering, one each in Fall River, New Bedford and Providence, giving certificates at the end of two or three year courses, one in Philadelphia, also granting certificates, and six in the southern states of North and South Carolina, Georgia, Alabama and Texas, giving degrees of Bachelor of Science in Textile Engineering, at the end of four years work.

This inquiry was conducted under the sponsorship of the Textile Foundation, and the inspiration and guidance of a Special Committee of the Foundation of which Karl Compton of Massachusetts Institute of Technology was Chairman, and Robert H. Doherty (then Dean of Engineering at Yale) and Dr. Brooks (then President of the North Carolina State College) were members. As a result of this inquiry, several suggestions were made, one of which has special reference to the subject in hand. The graduates of these institutions, both employees and sub-executives in the textile industry, all stressed the hope that something could be done to give future graduates a better knowledge of the "economics" of the industry. I purposely quote the word "economics" because I have found this may mean anything from wage fixing to marketing, depending on the man with whom you are speaking. It seldom in practical business means what the teacher of economics defines under that head. Parenthetically, may I say that this field of activity needs a dictionary of terms so that both engineer, natural scientist and social scientist mean the same thing, when they discuss related subjects. The various ideas and suggestions in the report were drawn together under two broad recommendations among others: (1) That the heads of the schools give consideration to the number of hours then available for non-vocational and non-technical subjects and (2) Discuss how better use could be made of the time already available for these subjects.

As a result of these recommendations and the discussions between heads of the textile departments and of economic departments, it was mutually agreed that something could be done to increase the working knowledge of the textile graduate in economics

and related business subjects, providing teaching materials were made available.

To make a long story short upon the recommendation of the deans and heads of the schools and of the teachers of economics, a group of professors and instructors of the Wharton School of Business, under the direction of Alfred Williams of that Institution and the sympathetic coöperation of Dean Willets, have prepared and are now distributing for an experimental year of teaching, textile information in teachable form under four headings: General Economic Information, Textile Mill Management, Textile Costing from a Management Viewpoint and Textile Marketing.

As further illustrative of both the time needed and the temper of those undertaking this fine piece of coöperative educational development, there was held within the last two weeks a ten day seminar for teachers of economics and allied subjects. Fifteen men from ten school faculties, visited mills, distributors, financial houses, and retail and wholesale textile establishments in New York and vicinity, and in between discussed how they could better give the textile students a deeper understanding of the economics of textiles. I know of no educational inquiry which has started with a report and recommendations and continued in so fine a spirit to carry out its findings, even to breaking down the barriers between departments in the same institutions, because of a mutually helpful desire to do the best job of training possible.

The Inspiration of the Teacher

And almost lastly, we come to the teacher, himself. Most of us, had we the ability, could write a personal experience of the inspiration and "push" given us by some teacher, like that moving story "Good-bye Mr. Chips." My own course in life was influenced deeply by two of my own college professors—one of them the head of the department of electrical engineering, the other the professor of economics and government. There is a way to teach an engineering subject so that it has social significance in our later years. I worked two years in a machine shop, but failed to relate machine operations to costs until after I was graduated because I was a "bum machinist," and spent my time and my instructor's patience, I presume, getting that half thousandth grinding fit. So above books, above curricula, above subject, we put the personality and perspective of the teacher. If the engineer is to be related to his social and economic responsibilities, the teacher will have a large part in that molding. He as well as the student needs courage and inspiration. The successful engineer by training and work tends to be conservative. As the engineer, so the engineering teacher, because we are all pretty much cut off the same pattern. We think

in terms of "factors of safety"—so to speak. As a rule, we are not much given to emotion, in fact we often misjudge the proportions of the parts of a social-engineering-economic question because we discount the emotional reaction of the average man. And yet at heart, I do not know of a profession or class which has a higher percentage of altruists than that of engineering. In local public affairs, of a non-political character, in the church, the school board, the engineer serves with a sense of contributing something for the community good. Yet, he generally is not blinded by the fact that there are degrees and qualities in altruistic endeavor. He tends to be the "how" man on the board or the committee. All these are attributes of the teacher of engineering as I have met him and it is these qualities which we pass on to the young men, whom we wish at times would more uniformly "seek learning" in our engineering colleges.

The Deeper Purposes of the American People

So we come to the end, as educators who seek to make a contribution to the ideals of tomorrow and to pass on to young men some concept of what we may call American principles. What is our answer to the many apparent conflicts. On what foundations may we build the future? In what may we trust in the turmoil of ideas that are projected? To clarify my own position, I tried to think through some months ago what I believed to be the deeper purposes of the American people. As most of you know, my business desk is in Washington where the political leadership of many clashing policies holds forth. If you will again pardon a personal note—I found it necessary, at least for my own peace of mind, to set up some articles of faith against which to test the purpose and performance of the diverse philosophies and often diametrically opposed procedures. In closing I would like to give them to you, as teachers, for what they may be worth in harnessing the mind of the future engineer to social and economic questions.

Engineers are found in every branch of American industry. Never before in the history of the United States has an attempt been made to inject a national, political and social policy so rapidly into individual business policy. Proposals which seemed academic a few years ago have become, by government action, at least temporarily, the guides in determining wages, prices and costs in thousands of enterprises in which engineers are engaged. You have felt with me the deep unrest of those at present the responsible heads of industry as to what is to be the future economic system of the United States. Under the impelling publicity of one group of philosophers in Washington it looks at times as though the factory and industrial system with which engineers have had so much to do in building,

and the progress that has been made in invention, in technology, in business management and organization, were all forgotten and that for our American capitalistic system there was to be substituted one of the philosophies of collectivism. On the other hand, there have been times when it must have seemed to you, as it has to me, that industry, badly led and with dramatic examples of common dishonesty, was doing its utmost to provide emotional ammunition to those who seek to destroy the complex structure of trade and industry which we have raised in the last one hundred and fifty years.

Some months ago I visited for the first time in West Texas and learned, curiously enough, also for the first time, that the "Staked Plains" of my early geography days were so named because the Indians and early pioneers, unable on a sunless day to sense direction on this immense treeless plateau, marked the trails with stakes, so as not to get lost.

In somewhat the same fashion, it seems to me, during the last hundred and fifty years the American people have set up certain stakes, or deeper purposes, which enable old and new trails to be located and give us a sense of direction. If we still have faith in these deeper purposes of the American people we can perhaps evaluate these undigested trends and swings and keep a clear pattern of purpose.

The first stake may be labeled "a love of justice." Much of the present turmoil and rush to law to prevent and change present practices comes from a deep sense of injustice. Any temporary panaceas that in themselves create new injustices, will not be accepted by the American people as a final policy.

I know of no group of men who inherit and foster by education and training this American principle more than the engineer and the engineering teacher. If the teacher of engineering can inculcate on the basis of his training in facts, a love of justice, then he will have done more to relate the young graduate to the social and economic questions of his day than by trying to find an advance solution. Such a young man may by his judgment, his balance and his sympathetic understanding of both sides of the capital-labor issue, for example, make a contribution to the happiness of his generation.

Just as deeply rooted as the love of justice is my second stake, the desire in America for an equal opportunity for all. This does not mean that all are capable of taking advantage of equal opportunity but every true American knows that there should be no layers of class in the United States and the road should be open to the top for the man who has the ability and capacity to create and produce. No government proposal that thrusts a gateway across this path of opportunity will ever persist in America. Temporary obstructions

may be raised but as soon as it is apparent that the proposal is an obstruction, it will just as surely be torn down.

Here again it seems to me that we, as engineers and as teachers of future engineers, have an opportunity to clarify the muddiness of some of the present emotional thinking as to the Equality of Men. To lump the lazy with the energetic, the moral pervert with the clean liver and call them all "the underprivileged" just doesn't make American commonsense. The engineer, of all men, should be in position to stand up for, and believe in, creative ability and to see that it is rewarded.

An intolerance of special privilege is a third marker on the American trail of policy, whether it be in politics or in business. The American people as a whole for a short time, or occasionally for what seems to be a long period, will "stand for" special privilege, but sooner or later that intolerance of special privilege which is embedded in the core of true Americanism will have its way and we then vote out of office political machines overweighted with graft, or we destroy industrial enterprises which build profit on monopolistic privilege only.

Again, the engineer-trained mind has a responsibility and opportunity. It is not the engineer who has been responsible for the pyramiding of organization on top of organization to develop products of science and invention, but unless the engineer who has the knowledge to separate values of "service" from values of "water," speaks his mind clearly, many economically and socially sound corporate structures may be discarded in a wave of emotional misstatements of facts.

And finally, there is in America, as every man knows who has been responsible for the growth of his own enterprise, as every great leader of any movement knows, a crusading idealism that will not be downed in spite of adversity. We do not in this country fumble our way through problems; we leap over them with a quality of heart rather than with a quality of mind. A Rhodes Scholar, visiting this country and making a comparison of colonial policies, as he called them, of the different nations, said to me "America's policy is one of altruism fundamentally. She always relates herself to another nation by establishing health, schools and roads as a basis for that nation's development." "This," said he, "is a policy of altruism."

These, it seems to me are the deeper purposes of the American people, which we need to make clear in the minds of our youth. If we will not poison the wells of fact so that all sides of a question can be illuminated and if we believe fundamentally that these four statements are at least a part of the deeper purposes of the American people, no man need fear the future.

By JOHN S. DODDS

Professor of Civil Engineering, Iowa State College

Teachers are quite logically concerned about the social significance of the engineer. Engineering teachers did not find themselves established in the halls of learning ordained from heaven to guide the technically minded youth into places of usefulness. They came into the scene more generally from the active participation in productive activities and have always been students of ways and means to improve their product. This Society exists for that very purpose.

It is quite natural, then, when personages in high places send out the word that the engineering colleges must do this and that to correct a situation which other professions could not handle, that the teachers ask themselves the question: "What is the social significance of the engineer?" Of course the first question will be followed by another: "What can the Engineering colleges do to make the most of the social significance of the Engineer?"

The charge has been published abroad that the engineer is the one who has, by his inventiveness, created a plethora of productive capacity without building up a consumptive demand to keep pace with it. Whether this is entirely true or not, it is probably good philosophy to admit that there seems to be a crippling degree of unbalance somewhere and those who cannot solve the problem have brought it to those whose business it is to work out the right answers. In other words, they have come to the proper place at "long last."

We will waste no time blaming financiers, investors, and politicians but will endeavor to work out something for those who have failed. We engineers are the first to feel the effect of economic and social unbalance and the last to be restored to equilibrium. We are, therefore, ready and willing to take over the next step in governing the forces which have been released by invention and production.

It may be said that engineers by their very nature made up that part of society which, at an early period, figured out better ways of doing things. For the purpose of this discussion it will be assumed that engineers, by whatever name they were designated, confined themselves to this one field during the early stages of civilization. Other persons took the ideas of the engineer and executed them. During this first stage the improvements conceived by engineers and ofttimes executed by others were largely elementary in character. The problem of maintenance was quite simple and such as it was it was given very little consideration.

In another and more recent period engineers conceived such complex improvements that engineering specialists had to be developed to bring them into being. During this modern stage engineers branched out and took on new titles to fit the things they were making or doing. Of course, this upset society in a measure because a new group of persons called mechanical and electrical and chemical and other engineers took a lot of important productive positions and sort of shoved the hereditary prominent people along a bit where they busied themselves with what might be called promotional occupations. Unable to manage the present situation without the aid of engineering training, these executives have now come to the engineers in desperation saying: "You have invented these things; you have constructed them, now you will have to keep them working." So we seem to face a new phase in the social import of the engineer when he is being asked for the first time to take full responsibility for the balancing of economic forces from start to finish.

In the first stage the engineer was asked merely: "Can this be done?" Then later, he was asked: "Should it be done?" Now the question is: "If it can and should be done, how shall we do it?" Now the engineer is expected to get the right answer. He will not expect to find it in the handbooks. Remember, the engineer has no traditional hidebound feeling of omnipotence. He knows his limitations. He assembles all the available aids to problem solving. The others who have failed have figured that the answer was entirely in their own field. They were not ready or willing to seek the help and advice of the other professions.

The sociologists have believed the answer was in social service; the financier tried to find it in money policy; the economists in controlled production.

The engineer will seek and use the aid of finance, sociology, economics, etc.; he will not lose sight of the teachings of the past; he will calculate the possibilities of the future from results predictable on the basis of a complete analysis of assembled facts. His planning will, if he is given full authority, be comprehensive and not casual. It is not proper or necessary to list here the outstanding examples of stupendous problems comprehensively worked out by and under engineers. Their number is impressive and their successful solution is common knowledge.

The engineering teacher of today fits into this job of training the engineers who will finally solve this distressing problem. From the astounding percentage of engineers actually engaged in public works activities today it is apparent that government has turned to the engineer for help to an impressive degree. Parenthetically, the number of engineers available for these emergency jobs indicates

the very sad lack of private employment open to these same engineers as this emergency developed. This is an indication of the accuracy of the statement made above which infers that those in charge of engineering employment do not rely upon engineering talent in the early stages of an economic depression.

The engineers who are available for emergency work are of all grades and capabilities from the highest to the lowest. The traditional depression layoff of engineers hit competent and incompetent alike. Many organizations failed to take back some very good men when reëmployment was again possible because of current age limitation and retirement ideas. Many of the best of these high grade men who were dropped and not subsequently taken back have now gravitated to important emergency governmental positions and are engaged in the solution of the distressing problems of these times. Some of these have been heard to complain that the colleges do not properly equip their graduates for present day situations. Some of this criticism relates to men who are "square pegs" who did not fit into the previous work and would probably never pass inspection as an acceptable product in any production line. The rank and file of graduates of the engineering colleges are working into place in a reasonable period and are able to do the job for which they have been trained. This indicates that the institutions are turning out an acceptable product except for the occasional defective part occasioned by faulty raw material or workmanship or inspection rather than by improper production facilities. The colleges are alive to the defective raw material and try to eliminate that before a student has gone very far. They realize the problem of faulty workmanship and are trying to reduce that to a minimum by encouraging efforts to improve teaching. They think the quality point requirement for graduation will improve the inspection of finished product and eliminate nearly all of the defective parts.

The teacher's job is to understand the social significance of the engineer and keep turning out a product which does fit the needs of the times. With this in mind it is the duty of the teacher to see that the curriculum is broadly fitted to the educative purpose. He must have a personal knowledge of the market which his product is to serve. Mr. Feiker has made such a study on a comprehensive scale for an individual branch of industry. Each teacher must know enough about what is going on in the world, preferably from personal experience, to make such a study for the product of his classroom. This will be discussed at more length later in relation to the teacher's own contribution to the solution of social problems as an individual.

How can the engineering teacher be of the most service to his

students in this matter of understanding and portraying the world into which the graduate will go?

Some will leave such matters to a placement or personnel department and devote all available time to technical subject matter. These men glory in research and seem to begrudge the time spent in the classroom. Teachers who are really great, teachers who rise above their fellows, inoculate their students with something which is not printed in the books. They lift their students out of the rut of mere technical application and into the realm of "use and convenience of men." In other words, the truly great teacher is consecrated to his subject, to his students, and to the world in which he lives. He teaches his facts and theories in relation to other men and materials. The teacher who rises above his specialty and helps his students understand the social significance of the engineer is successful.

It is not enough to teach a student how to design a machine or to build one or even to operate it. He can and should be led to see how the machine and its output will fit into the general scheme of things. He can visualize enough of the social and economic picture to realize who will be benefitted, who will be displaced and what will be created to take up the displacements.

A teacher must inevitably take an active part in public life if he is to be able to impart this sort of inspiration to his students. There is nothing more true than the fact that there is always work for the willing. If a teacher wishes to participate in public affairs he needs to buy no advertising space or make a public announcement to get an opportunity. His first chances will come as the natural consequence of his helpful friendliness in the classroom. He will be invited to help with the Y. M. C. A., and kindred student organizations. He will soon be in demand with other organizations depending upon his capabilities, running all the way from Scouting through Sunday School, Choir, Social Service, School Board, City Council, Recreational Commissions, Planning and Zoning Boards, and State Commissions.

His talents along public service lines will appear as he serves upon faculty and technical society committees and each will serve to give him an insight into the behavior of other persons. Gradually he will be called upon to serve in broader capacities in state and nation because his name will come to mind in the councils which are suggesting persons qualified for service. In each of these opportunities the teacher will absorb inspiration which will make of him an exponent of sound public service based upon the knowledge of real public need. The teaching profession is outstanding in the latitude available for engaging in such activities with institutional encouragement.

The teacher who engages in one or more of the suggested outside activities transmits his interpretation to his students, who upon graduation scatter to widely separated places where the knowledge is useful and the renown of the teacher is spread.

The Civil Engineering Department of Iowa State College is engaged in a comprehensive study of the success with which her graduates meet the social significance of the engineer. In other words the department is making an effort to find out from each graduate how well he is fitting into the economic situation where he finds himself. The study has not advanced far enough to be conclusive but there is apparent correlation between the efforts put forth by the young men subsequent to graduation and, along educative lines, and his success in his field and his position in his community.

Many graduates who come before the Iowa Board of Engineering Examiners to be examined for registration make a rather poor showing because they lack that spark, which some teacher might perhaps have kindled, that spark which keeps alive the desire to get ahead by means of better and more intelligent work. These men know fairly well the subject matter they learned in college and the one or two things they have done since then but very little more. They fail or they just barely pass while others ride gloriously through because they have grown with their opportunities. Even for the mediocre graduates the education was, perhaps, a good investment because the scale of compensation averages enough better than that of the mediocre uneducated men.

The distressing percentage of those who drop into a rut of complaisancy upon graduation to wake up too late that they are still only a small way up the ladder from the rank and file causes the college teacher to wonder what he can do to increase the percentage of those who grow and reduce the number of those who stand still. Our study strikingly shows our graduates strung out along a rising curve from mediocrity to a place of outstanding brilliance. Men who have loafed their spare time away look up with envy toward those men who have continued to burn the midnight oil. Year after year the one diminishes in utility while the other becomes more indispensable. One becomes more dependent upon the whims of fortune while the other becomes the fortunate one whose whim may be failure or fortune to the other. All of which clearly indicates that any thought which this group can give to the subject of the social significance of the engineer and its implications to the teacher is well directed.

One complaint frequently voiced by graduates and those who use graduates is that the engineering curriculum should contain more of this and that non-engineering subject such, for example,

as economics and business law. In answer to this it may be said that the engineering college faculties have restudied their courses again and again, pinching out more and more of the practical engineering subjects until any further dilution is hardly possible if our graduates are to be called engineering trained. The successful graduate rarely carried away from college enough of the liberalizing subjects to account for his progress. Instead he took with him the desire and ability to study and he kept at it. As each new opportunity appeared he saw it and was ready for it. His success was due to the work he did after college as much as to the learning he acquired in course. His inspiration probably came from contact with one or more teachers or others who were conscious of the proper place of the engineer in society and were able to inoculate the student with the correct virus to produce the chronic case of dissatisfaction with mediocrity and a desire to excel.

The teacher is not the only one who should be able to visualize what use may be made of the engineer. In our study we have found relatively few employers who encourage activities in leisure time which will serve as continuation education. The reading program of the average young engineer is woefully lacking in professional value. Since the average graduating engineer does not seem to have the compelling urge to educate himself for further opportunities it would be quite proper for the entity that employs him to offer inducements for continued study in some attractive way. Thus a larger proportion of engineering graduates would become problem solvers instead of mere operators. After all if it is profitable to breed hogs that produce better bacon in half the time with the same amount of feed it is likely to pay to have young engineers around the organization who produce better results in less time on better pay.

It may be necessary for teachers to do some missionary work of the sort suggested among employers in an attempt to induce them to promote post graduate study in the ranks of their employees, possibly with some college help and guidance.

Many firms and employing organizations do not encourage attendance by their engineering employees at professional society meetings and participation in their activities. This is as if a man bought an automobile and operated it continuously at low speed because he did not know of the higher gears. The societies offer one of the most useful educational opportunities open to the practitioner. No man can serve his employer best who does not mingle with his fellows at such meetings and give and take new engineering ideas. To get the most valuable service from an engineer the employer might well be encouraged by the teaching profession to promote continuation study, participation in engineering society affairs and a moderate interest in civic matters.

Engineering teachers as a group contain many who are highly active in many fields other than actual teaching. Some of them are so busy outside that their institutions must relieve them of much of their normal load of teaching. We find them on state and national planning and consultant boards. They are prominent in the conduct of technical and professional societies of locality, state and nation. A glance at the roster of past presidents of such organizations will show a very high representation of teachers. This recognition as leaders by men of their own profession is the highest form of tribute.

Very few teachers seem to be active in politics. This is easily explained because a teacher is supposed to be unbiased and politics is partisan. The teacher has the right to his own opinions on political matters but if he is employed to teach engineering he had better keep his partisan politics out of the classroom. This does not preclude instructive discussions in class to explain political implications in the active world. Many engineering teachers serve on local school boards and boards of aldermen with continued credit to the teaching and engineering professions. These men are the outstanding representatives of the profession. There remain all too many who can tell you what they will have for next Sunday's dinner and what Andy Gump has been doing, but they cannot tell why taxes are high. They live regular lives from the ringing of the alarm in time for their first class in the morning to the evening movie or bridge. They always have their grades in on time and the grades are apt to be mathematically correct and heartlessly unfair. They serve on few committees and they do nothing to help in local civic affairs. Such teachers seem to have a sublime trust in "Santa Claus" and look for gratuitious increases in salary as their right. They spend enough time speculating upon the probability of increased pay to earn such rewards if the time were directed toward self improvement in one or more of the ways herein enumerated.

In conclusion it would appear that if engineers are to be called upon to help solve the days' problems in non-technical fields the teachers may well do what they themselves can in participating in public affairs. Thus they will not only do their part in improving unsettled conditions but will be able to impart to their students much valuable instruction and inspiration not ordinarily taught in the classroom. The teacher must be aware of the importance of the profession in the life of the day and lead his students along lines which will make them fully alive to their opportunities and obligations to society in ways not ordinarily considered within the purview of the engineer.

NEW MEMBERS

ALFORD, L. P., Professor of Administrative Engineering, Chairman, Industrial Engineering Department, New York University (reinstate).

BOARTS, ROBERT M., Associate Professor and Head, Department, Chemical Engineering University of Tennessee, Knoxville, Tenn. Chas. E. Ferris, F. L. Wilkinson.

CAMPBELL, ROBERT M., Professor of Ceramic Technology, N. Y. State College of Ceramics at Alfred University, Alfred, N. Y. A. F. Greaves-Walker, J. L. Carruthers.

CATHER, HAROLD M., Assistant Professor of Machine Design and Construction, West Virginia University, Morgantown, W. Va. L. D. Hayes, W. W. Hodge.

HOLMES, MAJOR E., Dean, N. Y. State College of Ceramic Technology at Alfred University, Alfred, N. Y. A. F. Greaves-Walker, J. L. Carruthers.

HUCKLE, MYRON S., President, U. S. Diesel School, 329 Park Street, Boston, Mass. L. T. Brown, A. E. Norton.

JESSUP, WALTER E., Field Secretary, American Society of Civil Engineering, 33 West 39th Str., New York City. C. E. Davies, G. A. Stetson.

MCCLURE, OSCAR E., Associate Professor of Physics and Electrical Engineering, Ohio University, Athens, Ohio. A. A. Atkinson, J. H. Clouse.

NORTON, FREDERICK H., Associate Professor of Ceramics, Massachusetts Institute of Technology, Cambridge, Mass. A. F. Greaves-Walker, J. L. Carruthers.

PARMELEE, CULLEN W., Professor and Head, Department of Ceramic Engineering, University of Illinois, Urbana, Ill. A. F. Greaves-Walker, J. L. Carruthers.

SCHURECHT, HARRY G., Professor of Research (Ceramics), N. Y. State College of Ceramic Technology at Alfred University, Alfred, N. Y. A. F. Greaves-Walker, J. L. Carruthers.

SPEIDEN, HENRY W., Assistant Professor of Civil Engineering, West Virginia University, Morgantown, W. Va. G. P. Boomsliter, R. P. Davis.

STONE, ROBERT L., Instructor in Ceramic Engineering, North Carolina State College, Raleigh, N. C. A. F. Greaves-Walker, J. L. Carruthers.

SYNGE, JOHN L., Professor of Applied Mathematics, University of Toronto, Toronto, Ont. F. L. Bishop, Nell McKenry.

TAYLOR, DONALD W., Research Associate in Soil Mechanics, Massachusetts Institute of Technology, Cambridge, Mass. J. B. Babcock, E. Mirabelli.

VAUGHAN, WILLIAM H., Director, Engineering Experiment Station, Acting Head, Department of Ceramic Engineering, Georgia School of Technology, Atlanta, Ga. A. F. Greaves-Walker, J. L. Carruthers, F. M. Feiker.

WATTS, ARTHUR S., Professor and Chairman, Department of Ceramic Engineering, The Ohio State University, Columbus, Ohio. (Reinstate.)

WHIPPLE, GEORGE H., Educational Director, Associated Manufacturer, 50 Beacon Street, Boston, Mass. Carl S. Ell, J. W. Zeller.

WHITTEMORE, JOHN W., Professor of Ceramic Engineering, Virginia Polytechnic Institute, Blacksburg, Va. A. F. Greaves-Walker, J. L. Carruthers.

ENGLISH NOTES

DEVOTED TO THE INTERESTS
OF TEACHERS OF ENGLISH
IN ENGINEERING SCHOOLS

J. L. VAUGHAN, EDITOR

SOURCE MATERIAL FOR COURSES IN TECHNICAL WRITING

Students of English composition find their examples in the literature of the day and in that older and dateless literature which we call "classics." Engineers in similar study are not so well supplied with material for classroom analysis. The classics of science, for example, the writings of Faraday, Tyndall, or Huxley, are not dateless because their assumptions are frequently outmoded and their material almost always less complex and mathematical than present knowledge requires. When atoms were uncut a dissertation on physics was simple and easy to compose. The atom of today with its various component elements, its quantized conditions and its chemical ambiguity presents a more serious problem to its expositor. The radio of Marconi can be described for the comprehension of an eighth-grader but the system for transmitting 240 simultaneous telephone conversations over a coaxial conductor will strain the ingenuity of one who tries to explain it to a business man.

Explaining to business men is one of the necessary tasks of all engineers; and technical-school courses in English should provide some methods and experience for that life work. Their instructors may need source material; and good examples of technical exposition are not easily found in periodical literature.

It is, therefore, a pleasure to announce that *Bell Laboratories Record* is available on a complimentary basis to English Departments in technical schools of college grade. This magazine publishes each month six or seven articles, 1,500 to 3,000 words in length, which are of interest to students of physics, chemistry, or electrical engineering. The articles are usually worthwhile examples of how successful engineers describe their accomplishments.

They vary in style with subject matter and with the particular background of their authors; but all of them appear to lie within certain editorial limits which give the magazine its individuality. Most obvious to one who analyses the articles is their usual practice of starting from generally known facts and then proceeding on a gentle gradient to introduce the engineering problem and the factors of its solution.

The Editor of "English Notes" is also informed that reprints are available of the provocative article on "Technical Exposition for the General Reader" which John Mills wrote for this journal a few years ago. That, its readers will remember, emphasized the inductive order which is frequently illustrated in *Bell Laboratories Record*. To obtain reprints or to be placed on the mailing list for the *Record*, write on your official stationary to the Bureau of Publication, Bell Telephone Laboratories, 463 West Street, New York City.

ENGINEERING ECONOMY PAGE

EDMUND D. AYRES, University of Wisconsin, *Editor*

MIMEOGRAPHED LETTER SHOWS WIDESPREAD INTEREST

A mimeographed letter was sent out to a sample portion of the S. P. E. E. membership in June. The returns have been gratifying. They are proof of a widespread interest in the work of this page.

Scope of the Term "Engineering Economy"

To start off, your editor made the following statement: "I firmly believe that engineering economy as practiced in the work of the Society embraces at least the following fields of subject material: (1) Engineering costs, (2) Shop and factory management, (3) Business administration for engineers, (4) Personal and placement matters, (5) Public service matters, (6) Social studies and humanities for engineers."

A few selected pertinent comments from others are:

". . . I suggest that the field of engineering economy can be considered as it affects: (*a*) the production and distribution of services; (*b*) the production and distribution of material goods; (*c*) human relationships; (*d*) the self-development and economic training of the engineer." F. H. Achard.

"Broadly speaking, I think the outline of the field covered does embrace the fields of subject matter mentioned in your letter, ..."—Emmett B. Carter.

"I realize, of course, that all or practically all activities have their influence on engineering economy. I am just interested to know why you specifically included items 4 and 6 in your list."—Howard L. Davis.

"I agree wholly with the classification given by Professor Ayres, with one exception, namely, the group which he lists as Group (2), 'Shop and Factory Management.'"—Hugo Diemer.

". . . , I am not convinced that numbers 4, 5, and 6 pertain exclusively to engineering economy, ... I am inclined to think that engineering economy is concerned with those three and should consider those three, but I doubt if engineering economy can claim full jurisdiction or control."—C. J. Freund.

"You have enumerated six fields of subject material in engineering economy. In the light of present-day progress, I feel that you have omitted a very basic one, that of 'Legal Recognition of Engineers and Engineering Qualifications.'"—Harry E. Harris.

"In your outline you embraced the field very broadly and the immediate problems of balancing expenditure for 'this' against expenditure for 'that' in routine affairs are notably represented in the earlier items of the half-dozen which you have named, while the social relations which come into political economy *per se* are included more particularly in the latter items. I hope you will keep the distinction between the immediate best expenditure of money on the one hand and the social effects of large plans and the continued expenditure of money on the other hand."—Dugald C. Jackson.

"Your outline seems very satisfactory, except that I wish it might be extended to include the field covered by the committee of the engineering societies. . . on the 'Balancing of Economic Forces.'"—R. B. Ketchum.

". . . It does seem to me better to restrict discussions of engineering economy to such problems as 'will it pay?'"—Paul T. Norton, Jr.

"The six divisions of the subject, which you outline, appear to me to be important and should each be dealt with in turn. . . ."—Walter Rautenstrauch.

". . . the six subdivisions of engineering economy that you list seem to be well arranged."—Milnor Roberts.

"Your set-up, as seen in the six points, is very good."—Julius C. G. Seidl.

"We are trying to develop a number of courses along the lines of engineering economy such as: Cost accounting, engineering marketing, personnel administration, and the regular academic courses in economics."—J. E. Walters.

SECTIONS AND BRANCHES

The sixth annual meeting of the **Missouri Section** of S. P. E. E. was held at the Missouri School of Mines, Friday and Saturday, April 9 and 10, 1937.

Following the registration of visitors at the Sinclair Pennant Hotel, the meetings began with an informal dinner at the Sinclair Pennant Tavern, Friday, April 9, at 6:30 P.M., seventy-two members and guests being present. Dean F. Ellis Johnson, President of the Missouri Section, presented Dr. Charles H. Fulton, Director of the School of Mines, who extended a hearty welcome to all visitors.

Following the dinner, a program of papers and discussions was presented at Norwood Hall on Missouri School of Mines campus. Dean A. S. Langsdorf presented the topic "What to Look for in Choosing an Instructor." J. W. Barley and E. A. Stephenson presented the topic, "If I Could Do It All Over Again." R. B. Vaile presented a paper on "The Ideal Administration."

Following an inspection of the School of Mines Laboratories, the morning session convened in the Physics Lecture Room at 9:00 A.M., when Dean Johnson opened the discussion on the talks of the previous meeting. The morning program continued with the presentation of the paper, "How to Organize a Course Properly," by R. W. Selvidge. The topic, "The Use of Calculation Periods" was presented by D. J. Peery. The topic, "Planning a Laboratory Experiment," was presented by L. E. Stout.

The following officers of the Missouri Section of S. P. E. E. for the school year 1937–1938 were unanimously elected:

President, H. H. Armsby, Missouri School of Mines.
Vice President, F. W. Bubb, Washington University.
Secretary, R. B. Vaile, University of Missouri.

The next annual meeting of the Missouri Section is to be held at the University of Missouri at Columbia, Mo.

I. H. LOVETT,
Secretary.

COLLEGE NOTES

Fenn College.—Burl H. Bush, for the last three years associate dean, has been made dean of engineering, replacing M. E. Nichols who has recently accepted a position as Educational Director of the American Steel and Wire Company. Mr. Bush took his undergraduate work at Annapolis, and received his Master's degree in mechanical engineering from the University of Iowa. He has been with Fenn College since 1931, and for the last three years as associate dean.

Gerald U. Greene has been appointed professor of metallurgy. Mr. Greene received his Bachelor of Science degree from the New Mexico School of Mines in 1923, where he majored in metallurgy, chemistry, mineralogy, and geology. In 1924 he received his Master's degree from the University of Utah, where he did research work under the direction of the Bureau of Mines Officials. His major there was in metallurgy. In 1931 he registered at Harvard where he studied under Albert Sauveur and others. He received his Doctorate in Science for this work. For the past several years Dr. Green has been employed in industry, three years of which were spent in South America working on processes for tin, copper, silver, bismuth, and antimony ores. For the past two years he has been a part-time teacher in the evening school of engineering.

H. E. Morgan has been appointed an instructor in physics. He received his A.B. from Miami in 1929, with honors in physics, and his Master's degree in science from Penn State College in 1931. He is receiving his Ph.D. from Penn State this spring. He will assist Dr. Poppy in the Department of Physics.

Clifford D. Williams has been appointed as associate professor of civil engineering. He received his B.S. in Civil Engineering from Fenn College in 1937. He has had additional graduate work towards his Masters and Doctors degree. The State Highway Department of South Dakota employed him for three years. He was chief engineer of the Mowbridge Engineering Company for two years, he was structure designer in the City Engineer's Office, Pasadena, California, for two years, and structure designer for the New York Central Railroad for nine years.

Nicholas Rimboi has been appointed full time as secretary to the dean of Engineering. He was graduated from the evening division of the College with a degree of Bachelor of Science in

Electrical Engineering in 1934. He will give special attention to the evening courses in the Technical Institute.

University of Kansas.—Ivan C. Crawford has been appointed Dean of the School of Engineering and Architecture at the University of Kansas.

The death of George C. Shaad last summer left the School without a head and, in the effort to obtain the best man available for the position, no appointment was made immediately, but during the past year the School has been directed by an executive committee of which Professor F. A. Russell is chairman.

The professional experience of Dean Crawford is largely in the field of civil engineering, but his contacts have been broad. He is prominent in the activities of the S. P. E. E., has served on the council, and as a vice-president. He is also active in the E. C. P. D. He is a member of Tau Beta Pi and of Sigma Xi and of numerous civil and military organizations.

He has also had a noteworthy military career; for 18 months he served as a major of engineers and for 10 months was in command of combat engineers in France and was graduated from the Army School of the Line at Langres. He is also a graduate of the Army War College and is now a Lieutenant Colonel in the Engineer Reserves.

NECROLOGY

Lester Robley Sailer, born July 14, 1906, died after a lingering illness on December 12, 1936. Mr. Sailer received the degrees of A.B., B.S., and E.E. from Columbia University, 1928, 1929 and 1930 respectively. During his undergraduate days he was an assistant in the Department of Physics and upon receiving his E.E. degree was appointed instructor in this department (E.E.). He held this position at the time of his death. Mr. Sailer was a member of the A. I. E. E. and of the S. P. E. E. He was active in University Honor Societies, being a member of Tau Beta Pi, Sigma Xi and Epsilon Chi.

BOOK REVIEWS

First Year College Mathematics, Part II, Mathematical Analysis. VOLNEY H. WELLS. N. Y., D. Van Nostrand, Inc., 1937.

"First Year College Mathematics" is "written for use in an introductory course and is designed to prepare a student for a mature course in the calculus."

The reviewer believes that this book is an excellent one for first year students who have been well trained in high school mathematics. Instead of the usual lengthy review of high school algebra, the student is presented with new ideas from analytic geometry. This introduction of mathematics to freshmen is surely a fine one to arouse the interest of the student. There are seventeen chapters in the book; the first chapter deals with directed line segments, distance between two points, point dividing a line segment in a given ratio, inclination and slope of a line, parallel and perpendicular lines, and an angle between two lines. The following chapters are called Equations and Loci Straight Lines, Functions and Their Graphs, Solution of nth Degree Equations, Rate of Change, Differentiation of Polynomials, Parabolas, Circles, Differentiation of Algebraic Functions, Central Conics, Curve Tracing, Integration, Parametric Equations, Transformation of Coordinates, Polar coördinates and Complex numbers.

The author's early introduction of determinants is a good feature of the text, for they can be used advantageously throughout the book. If one notices the order of the chapter headings listed above, he will see that the idea of rate of change is introduced a long time before the chapter on curve tracing. Also the chapter on differentiation of polynomials has two excellent articles on maxima and minima. Thus, the chapter on curve tracing is certainly far superior to the corresponding work in the usual course in analytic geometry.

The reviewer is not in accord with the author's introduction of polar coördinates. He believes that they should be presented early and developed simultaneously with the work in cartesian coördinates.

The most outstanding feature of this book is the numerous lists of well-graded exercises. The writer has divided these exercises into four Groups, A, B, C, and D. Those in group A are much like the ones worked in the illustrative examples. The exercises in group B are more difficult. The problems in group C, in general,

require much more thought than group *A* or *B*. In group *D*, additional theory is given and the problems are based on this new theory. Thus, the instructor is afforded a maximum of flexibility in determining the length of the course.

This book covers more mathematics than the ordinary freshman college course so that the student has a better chance to see how closely related are the subjects of algebra, analytic geometry, and elementary calculus.

Altogether the book is really an outstanding book of its kind and ought to become quite popular in freshman college classes.

JOHN C. KNIPP

Theory of Alternating Current Machinery. ALEXANDER S. LANGSDORF. McGraw-Hill, Publisher. 788 pages. $6.00.

From Professor Langsdorf's years of experience teaching alternating current theory, he has produced a real contribution to the textbook literature treating the theory of electromagnetic machinery. This new book is divided into thirteen chapters with problems at the back of the book for use with nine of the chapters. (There are 152 problems.)

One who examines the book carefully will doubtless discover that similarities or overlappings in the Direct and Alternating Current phenomena are being emphasized rather than certain lines of distinction. Explanations begin with familiar and basic principles proceeding with a logical and orderly method to proper conclusions.

In the thorough treatment given each type of Alternating Current Machine the order of presentation briefly stated is:

1. A qualitative analysis of physical relations inherent in the structure,
2. The representation of the entire complex, graphically i.e usually by vector diagrams,
3. The translation of these graphical relations into analytical form,
4. The mathematical development of the quantitative relations between the magnitudes embodied in the analytic expressions.

This method will receive the hearty approval of many teachers of this subject. It can be said without fear of contradiction that, many (if not all of us) find vectors not only helpful, but usually indispensable to analysis.

In some cases the traditional methods have been abandoned in favor of simpler, more rational ones. An example of this may be found on pages 90 to 93, where the analysis of phase relations in interlinked polyphase circuits are summarized.

The fact is not to be overlooked here that some 20 pages (382–402) are included on the "Doherty-Nickle Extension of Blondel's

Two-reaction Theory," and that in the study of induction motors beginning page 591 considerable space is given to the METHOD OF CONVERSION.

The first three chapters (128 pages) treat the subjects of current and voltage relations in singlephase circuits; the complex quantity; and polyphase circuits, while the major part of the book treats the various alternating current machines, beginning with the transformer, Chapter IV, page 130. Electronic devices such as mercury-arc rectifiers have been omitted. The book will be found very helpful in the pursuance of courses dealing thoroughly with the field of alternating current electromagnetic machinery.

R. C. GORHAM

Engineering Thermodynamics. NEWTON C. EBAUGH. Van Nostrand, 1937.

Professor Ebaugh has succeeded in condensing into less than 200 pages the essentials of engineering thermodynamics. Descriptions of apparatus and equipment are purposely omitted, the subject matter being confined to the physical and mathematical treatment of the basic laws and their applications. The style is unusually clear and readable. The reasoning sound and logical. The general arrangement is similar to that of Goodenough. Many illustrative examples are worked out in detail, a substantial number of well chosen problems are included, and a reasonable number of references are found in a short appendix. Mollier charts for steam and ammonia and a psychometric chart are also included.

The book ought to fulfil its purpose as an introductory text in a highly satisfactory manner.

J. A. D.

G-E *Campus News*

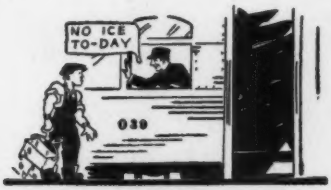
TURBINE STEEL CREEPS

IF the wrong kind of steels were used in turbine construction, the machine would not go creeping across the floor with the operator in hot pursuit, but the results might be even more disastrous.

Part of the increase in efficiency that has come about in the power-generating field in the last few years has been due to increased steam temperatures and pressures. As a result, the modern turbine shell runs, almost literally, red hot. This shell must withstand pressures such as exist half a mile down in the ocean and must keep a 20-ton rotor spinning perfectly in line. Heat softens metal, just as it softens candy, and permits it to stretch. This stretch, however, must be kept to the merest creep—about one part in 1000, if the changes are uniform.

In the Schenectady Works turbine shop, automatic electric furnaces hold samples of turbine steel at the temperature which will occur in the turbine. Gauges, which indicate changes of one part in a million, measure the creep as the pieces are exposed to heat for years at a time. From these tests, the best steel is selected.

It has been largely due to this research carried on by General Electric that the temperature and pressure of steam used in power generation have been raised to unexpected highs in the last few years.



ICE WATER

NEW electric drinking-water coolers introduced by General Electric have replaced the antiquated ice-cooled type on several prominent Midwestern railroads. This is another step in the modernization program being carried on by railroads to increase passenger traffic.

The new coolers are designed to overcome many disadvantages of the ice-cooled units. With foot operation of the self-contained units, only one hand need be used to get a drink. Cleanliness is promoted because of the absence of ice-filling operations, and the expense for maintenance and service is reduced to a minimum.

The water is automatically maintained at a healthful and refreshing temperature through thermostatic control. Coolers are designed either as self-contained units or as separate cooling and refrigerant condensing units for remote installations in the car.

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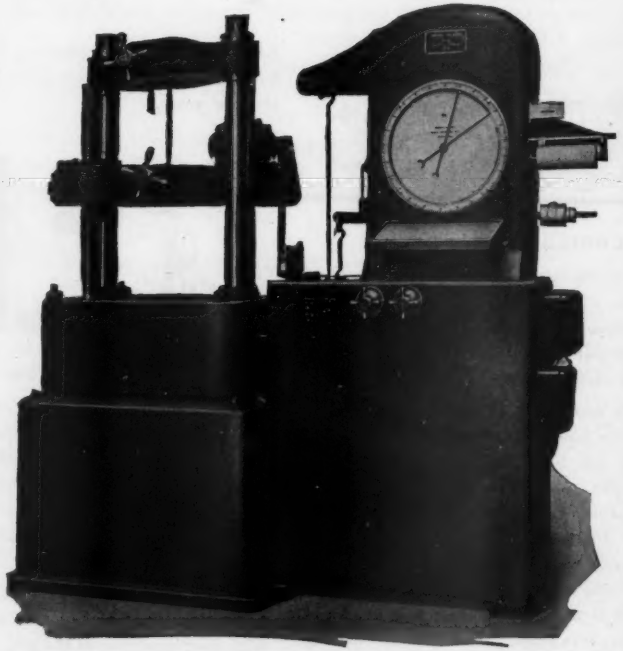

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